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## Preliminary Studies on the Natural History of Lung Cancer<sup>1</sup>

DAVID A. KARNOFSKY, M.D., ROBERT B. GOLBEY, M.D., and JOHN L. POOL, M.D.

IT IS, OF COURSE, not possible in a literal sense to discuss the unadorned, unmodified evolution of cancer in man, or what has been called its natural history. Many factors operative in the host and related to the anatomical location of the primary disease may act to vary or direct its course. A variety of complications may occur which, as far as the host is concerned, can overshadow the presence of cancer or prove fatal before it is well advanced. Treatment, even if not curative, can delay growth of the neoplasm in certain sites, or alleviate or prevent complications so that the disease can more fully realize its preordained course. Furthermore, our methods of observation are so limited, our clinical data so contaminated with errors of fact, omissions, and faulty interpretations, that what we believe genuinely to be true may only be misleading. At the outset we must emphasize that it is difficult even to approximate the ideal of a true and accurate description of the behavior of a cancer in anyone.

Despite the obvious evidence that this may prove to be an impossible task, a strenuous effort should be made to develop patterns of the growth and behavior of different forms of cancer in man, based entirely on clinical evidence. Such pat-

terns would be extremely valuable in planning therapy, in evaluating the effectiveness of proposed forms of treatment, and in detecting clues to some of the factors which may be regulating the growth of a cancer. We shall describe some of our preliminary efforts toward this objective.

### METHODS OF CLINICAL STUDY

*Individual Patient Records:* The fundamental desiderata for a study of the course of a disease begin with the individual patient. From an analysis of his medical history, together with many other detailed histories, will come data from which one may be able to develop characteristic patterns of each form of cancer. While we are all busy collecting clinical data by routine methods, we can digress here to say that these methods are largely inadequate for any detailed study. Records are kept in an episodic and conversational manner, with many critical gaps. There is little effort to interpret the significance of certain findings as the disease evolves, so that important clues to its evolution, apparent at the moment when the patient is examined, are lost. The occurrence of complications may divert the records to relatively minor problems, while the progression of the primary con-

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Presented as part of a Symposium on Treatment of Bronchial Cancer, at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2-7, 1956.

PATIENT: M.C. Male  
 ADDRESS: 200 Bay Boulevard  
 Newark, N. J.  
 TEL. NO.: ME 3-0009  
 DATE OF APPARENT ONSET OF DISEASE: Cough, chills, fever Feb. 1951  
 DATE OF ADMISSION TO HOSPITAL: 10-19-51  
 SERVICE: Thoracic  
 LOCATION: James Ewing 6  
 DATE OF ADMISSION TO HOSPITAL: 10-19-51  
 SERVICE: Thoracic  
 LOCATION: James Ewing 6  
 DATE OF APPARENT ONSET OF DISEASE: Cough, chills, fever Feb. 1951  
 DIAGNOSIS (WITH DATE AND PLACE):  
 CLINICAL: Carcinoma right lung 10-51  
 HISTOLOGICAL: (METHOD AND ANATOMIC SOURCE)  
 None  
 UNRELATED DIAGNOSES:  
 None  
 AGE: 12-24-01 50  
 (DATE OF BIRTH) (YRS.)  
 NORMAL WEIGHT: 125 lbs.  
 ADMISSION WEIGHT: 115 lbs.

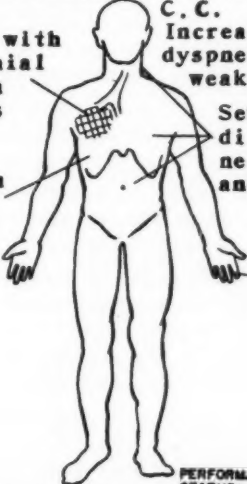
FINDINGS ON ADMISSION	
PREVIOUS THERAPY (WITH DATES)	CLINICAL EXTENT OF DISEASE
2-51 Treated for "virus pneumonia Penicillin 1 week Chloramphenicol 17 wks 10-3-51 Bronchoscoped for enlarging right chest shadow on x-ray 10-17-51 Repeat bronchoscopy with biopsy	Blood Pressure: 105/60 C.C. Dull, with bronchial breath sounds Medium moist rales Increasing anorexia, dyspnea, and weakness, 8 months Severe venous distention of neck and chest and abdomen Bilateral clubbing and cyanosis  PERFORMANCE STATUS: 50
SIGNIFICANT LABORATORY FINDINGS	
X-ray: Collapse of right lung HgB 9.3 WBC 9.5	

Fig. 1. Form I. This brief admission summary sheet contains identifying and diagnostic information at the top; a chronological listing of previous therapy for the present illness, on the left; and the physical and laboratory findings and performance status which summarize the current condition of the patient, on the right. This form is routinely made out for all patients admitted to our service. All of the forms represented in Figures 1-3 are duplicated and are available for distribution to interested staff members.

dition goes unobserved or at least unrecorded. For our purposes, it is essential that the evolution of the cancer be continuously recorded in a wide-angle manner.

One of the difficult points to communicate, obvious as it seems, is that cancer is a continuous and evolving process with an orderly, and to some extent logical, pic-



ACCESSION NO 246512

PATIENT: M.C.

Male

CHART NO.: 1199

X-RAY NOS 100-995

DATE OF ADMISSION  
TO HOSPITAL 10-19-51  
TO CHEMOTHERAPY

## DISCHARGE DIAGNOSES

Bronchogenic carcinoma right lung  
Superior vena caval syndrome

DISCHARGED TO (WITH DATE):

Expired 10-31-51

## IMMEDIATE CAUSE OF DEATH:

Massive pulmonary hemorrhage

WEIGHT (AT TIME OF DISCHARGE)

114 lbs.

AUTOPSY? Yes DATE 10-31-51

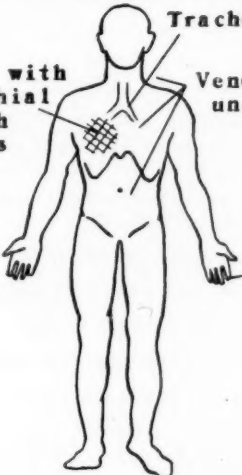
SUMMARY OF HOSPITAL COURSE	
THERAPY	CLINICAL EXTENT OF DISEASE
10-25-51 to 10-30-51 1000 KV x-ray to mediastinum and right chest (anterior and posterior)  500 cc. whole blood transfusion  Penicillin aerosol	
COMPLICATIONS	
None	
SPECIAL STUDIES	
None	
PERFORMANCE STATUS: 0 SIGNIFICANT LABORATORY FINDINGS Biopsy 10-17-51 showed only chronic inflammation BUN } Venous Pressure: Na } 10-22, both arms 400 mm./saline K } Within normal limits 10-29, right arm — Cl } 380 mm./saline CO <sub>2</sub> } left arm — Vital Capacity: 48% 340 mm./saline	

Fig. 2. Form II. This form is completed whenever a patient leaves the hospital. It continues the summary of therapy started on Form I and indicates any changed or new clinical findings or diagnoses. If the patient dies it includes a statement as to the most probable immediate cause of death. It also includes those record numbers which facilitate a later review of the entire case.

ture of growth and change, rather than a series of unrelated medical crises such as the moment of recognition and diagnosis, the drama of the attempt at cure, and in

many cases the frustration of inevitable dissolution.

In attempting to formulate patterns of cancer, we initially reviewed clinical

NAME M.C. AGE 50 SEX Male  
 DATE OF DEATH 10/31/51 POSTMORTEM 12½ hours  
 PATH. NO. 51-16753 AUTOPSY NO. 122

CLINICAL DISCHARGE DIAGNOSES: **Bronchogenic carcinoma right lung**  
**Superior vena caval syndrome**

CLINICAL CAUSE OF DEATH: **Massive pulmonary hemorrhage**

#### ANATOMICAL DIAGNOSES:

1. Epidermoid carcinoma of right main bronchus with infiltration of mediastinal structures and metastases to regional lymph nodes.
2. Massive pulmonary hemorrhage due to erosion of upper right main pulmonary vein by tumor.
3. Pneumonitis, acute and chronic, right lung.
4. Bronchiectasis and abscess, right lung
5. Thrombosis of innominate veins, secondary to tumor invasion.
6. Hypertrophy of right ventricular myocardium.
7. Focal myocardial fibrosis.

#### FINAL DIAGNOSTIC SUMMARY:

Marked invasion of all superior mediastinal structures without any evidence of distant metastases. The cancer was shrinking under x-ray therapy by clinical criteria prior to patient's demise. Adequate collateral circulation apparently existed for the innominate as well as the vena caval obstruction. Cor pulmonale probably contributed to symptomatology.

Fig. 3. Autopsy summary. This form is completed on all cases when the final autopsy protocol becomes available. It provides a final correlation of the clinical and pathological findings.

records on autopsied patients, but the information available in these retrospective studies was inadequate for our purposes. Recently we have turned to prospective record keeping, using techniques which should provide sufficient data to create the picture of the evolution of cancer in individual patients. Since these record-keeping procedures are still regarded as mildly experimental, they are kept only on patients on the Chemotherapy Service of Memorial and James Ewing Hospitals.

Our current procedures will be briefly described, because they may make our objectives clearer. The special records are at present prepared in addition to the routine hospital chart (1).

**Check Sheet:** On the first hospital admission, a medical history is obtained on a check sheet form, information being sought on negative as well as positive events. The check sheet may be modified as our knowledge of the disease increases. Medical histories are generally taken as an

PATIENT'S NAME		SHEET NO.	
M. C.		1	
PERFORMANCE STATUS	DATE 10/15/51	Hospital Admission DATE 10/19/51	DATE 10/26/51
	50	50	40
THERAPY- (preceding period)	none	none	10/25 Started R.V. x-ray therapy
SYMPTOMS	10/15/51	10/19/51	10/26/51
Appetite	+++	+++	+++
Weakness	++	++	+++
Anorexia	++	++	+++
Cough	++	++	+++
Wt. Loss	125 → 116	115	114
		Catharsis +	++
PHYSICAL FINDINGS	10/15/51	10/19/51	10/26/51
Clubbing	bilateral - fingers	no change	no change
Venous Distention	neck, chest wall + abdomen	no change	no change
Venous Pressure	Rt. arm - 400 mm saline	—	—
	Lt. arm - 400 mm saline	—	—
Breath Sounds	bronchial	no change	no change
Crackles	upper 1/2 Rt. chest	no change	no change
Vital Capacity	48%	—	—
U. COMPLIC. & DRUG TOX.			
LAB FINDINGS	10/15/51	10/19/51	10/26/51
Hgb. —	Plot. —	Hgb. 9.5 Plot. —	Hgb. 9.3 Plot. —
Wgt. 116	Wgt. 115	Wgt. 114	Wgt. —
WBC —	Temp 99°	WBC 9.5 Temp. 98°	WBC 10.8 Temp. normal
X-ray examination (with date)	Submitted films: 6/30/51 - density upper 1/2 of Rt. lung	Biopsy reported: Chronic inflammation	10/29 - X-ray: Lt. chest - neg. Rt. chest - small effusion medially midline
other lab. data	7/20 extension + progression 9/14 " "	2 electrolytes - within normal limits	
		Pap. smears - squamous atypical cells Class II	
TREATMENT AND PROCEDURES ORDERED	10/17	Admit for x-ray therapy	Continue x-ray therapy
Bronchoscopy	Spitum for cells	Infra-red photo of venous distention	
Consider for 1000KV x-ray and HN <sub>2</sub>			
Signed Smith	Signed Smith	Signed Smith	Signed Smith
			600 - tumor bar - Ant 225r tumor bar - stat 10/20 500r whole blood

Fig. 4. Work sheet. Entries on this sheet are made at regular intervals appropriate to the course of the disease. It indicates primarily changes in the objective and subjective findings and in treatment.

aid to diagnosis, but if the diagnosis is readily established, the historical analysis becomes less pressing and is often neglected. In a systematic study, however, a vast number of questions must be considered, which appear unessential in many instances but may later prove to be important.

**Form I** (Fig. 1): On hospitalization a brief admission sheet (Form I) is made out. This contains essential information, and is the key to the patient's record. The form must be short and simple or it will lose its usefulness. It is mimeographed and is available for distribution.

**Form II** (Fig. 2): On discharge, a second form is completed. This summarizes the treatment, the patient's response, and his status at the time of dis-

charge. Formal discharge diagnoses are listed. If the patient expires, an analysis of the presumed cause of death and the immediate terminal event are promptly recorded. This sheet is also mimeographed.

**Autopsy Summary** (Fig. 3): If the patient dies and an autopsy is performed, the findings are correlated with the clinical evolution of the disease. This material is also prepared in mimeographed form.

**Work Sheet** (Fig. 4): In the Out-Patient Department a work sheet is kept for every patient. This sheet contains a list of the signs and symptoms of the disease in the particular case and the criteria which are employed to evaluate its evolution. This list of criteria is adapted to progression of the disease, or to regres-

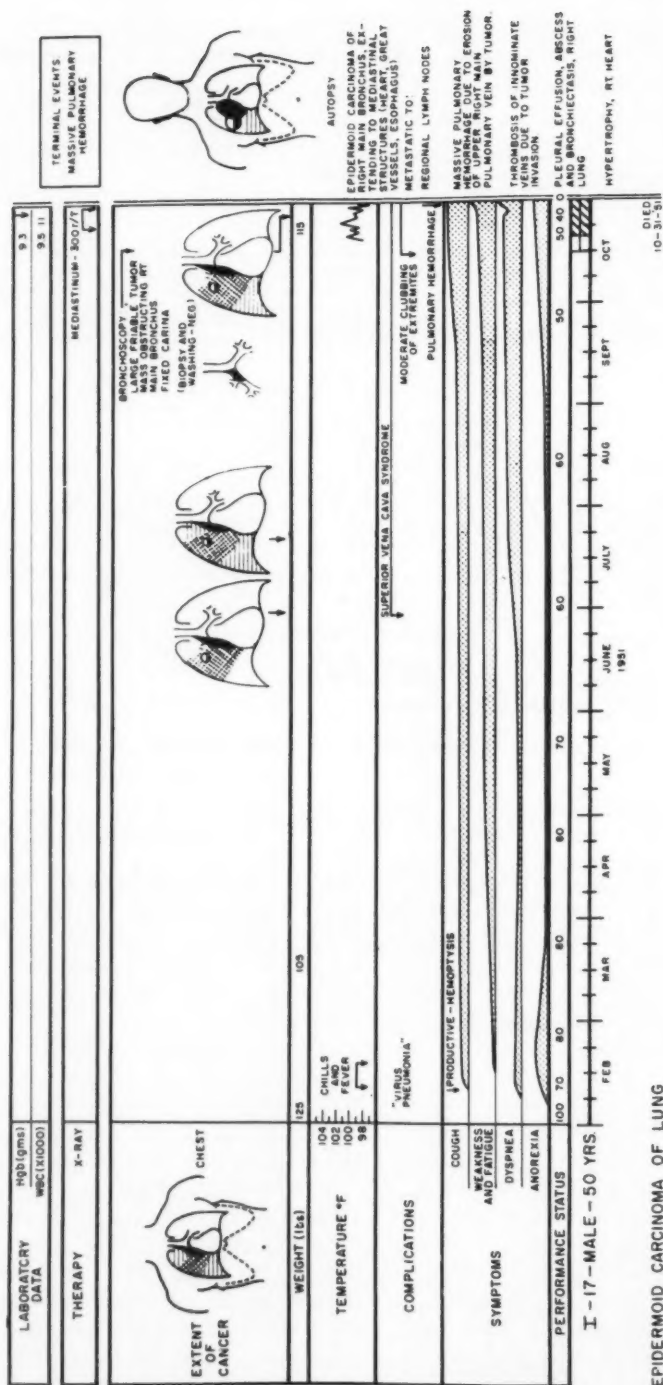


Fig. 5. Life-history chart. This chart summarizes the evolution of cancer in an individual patient. The clinical data are correlated with the autopsy findings. The technique of charting is standardized so that the charts can be readily understood and compared with others. With longer survivals a modified logarithmic time scale is used.

sion under treatment. By use of this work sheet, one can follow the growth of the cancer, its clinical manifestations, and the patient's status.

*Life-History Chart* (Figs. 5 and 7): For selected patients a life-history chart is drawn, presenting in a chronological

surgeons, pathologists, roentgenologists, and a technical staff. Thus far we have surveyed the records of 80 patients with proved pulmonary cancer who were autopsied at Memorial Hospital. While these records were taken at random, some degree of selection is undoubtedly

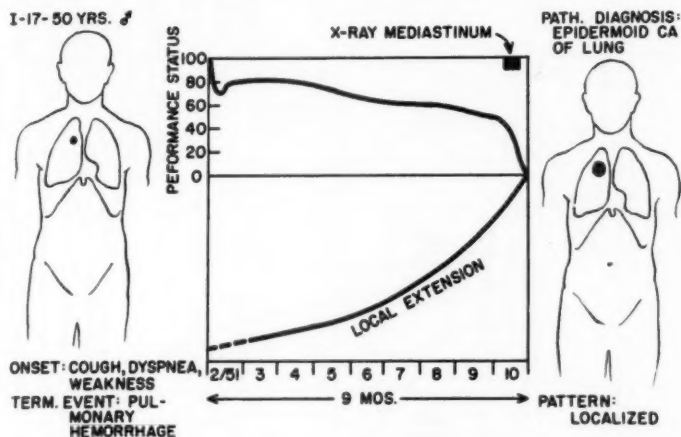


Fig. 6. Pattern analysis. This represents our analysis of the disease pattern presented in the previous five figures. The body outline on the left shows the clinical extent of the disease, while that on the right portrays that found at autopsy. This illustrates our "localized" pattern.

manner the synchronous events in the course of the disease; in other words, the relationship of signs, symptoms, tumor growth and treatment to time. We hope to define and standardize this technic of charting so that life-history charts can be readily used to exhibit the evolution of cancer in each patient, as well as to provide the basic data for definition of the clinical patterns of various types of neoplasm.

#### LUNG CANCER

It is our purpose to have such detailed records as we have described prepared on all patients, providing readily accessible clinical data and experiences in a complete, clear, correct, and compact form. While these methods are being used on all types of cancer, we shall concentrate here on the status of the work on cancer of the lung. While this is a preliminary report, it is a beginning. It represents the combined efforts of many people—internists,

involved: These patients died in the hospital with cancer (many die at home); they were autopsied (only about 50 per cent of our patients who die in the hospital are autopsied); the studies were retrospective, and the many deficiencies in the records have already been noted. We have as yet no figures worthy of statistical analysis. These data suggest certain patterns of lung cancer, which can be validated, refined, and corrected only by a much greater experience. We present them as a possible format into which subsequent cases of lung cancer can be fitted. The patterns are for such cases as are ordinarily seen, not for the exceptional ones which, being easily recollected, often form the basis for the physician's clinical impressions.

*Method of Analysis:* Cancer of the lung obviously begins as a local process in the bronchi or terminal bronchioles. The relationships between its beginning and its





Fig. 7. This is a second life-history chart which is somewhat more complex than the first. Figure 8 shows our pattern analysis of this case.

clinical onset must have a tremendous range. Rigler (2) has demonstrated, in a study of cases for which "pre-diagnosis" x-ray films were available, that a tumor may be present in the lung long before symptoms appear and, in fact, long before a shadow on the film is identifiable as a neoplasm. He has shown that in a small

long periods, or it may spread and disseminate. There are three inherent properties determining the behavior of cancer cells, not necessarily related to their anatomical location: *the rate of tumor growth*, *the ability of the tumor to metastasize*, which bears no necessary relationship to its rate of growth, and *the pattern of*

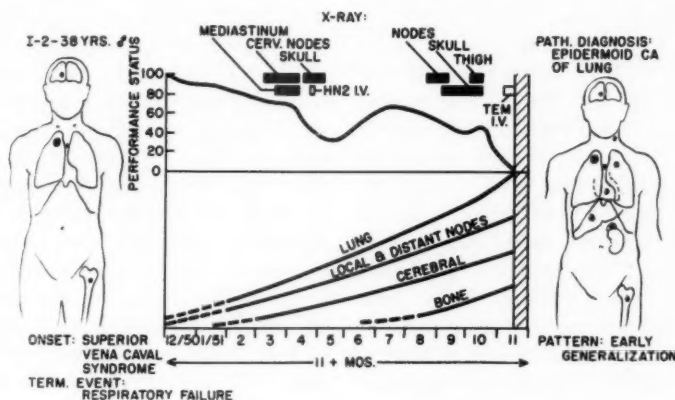


Fig. 8. This is an example of the "clinically early generalized dissemination" pattern.

series of inoperable cases the average duration of life was 22.5 months, while in a series of operable cases the average duration of life after the first x-ray evidence of disease (evaluated retrospectively) was 36.4 months. The average duration after the initial symptom in these two situations was 13.1 months and 19.4 months respectively. The most extreme case in the series had a duration of nine years after the lesion was first identifiable on an x-ray film.

As the cancer grows, its presence may be suggested by a chance chest film, or by symptoms which lead to a medical work-up; occasionally it may first be suspected from the discovery of a metastatic lesion. The date of *apparent clinical onset*, the date of *clinical diagnosis*, and the date of *histologic diagnosis* are important landmarks in the course of the disease. Yet, as is evident from the complexity of the clinical problem, these dates are subject to great variation. A lung cancer may remain localized for

*metastases*, that is, the predilection for certain organ systems. These, together with the location of the primary tumor, are determining factors in the cancer pattern.

The study of the precise meaning of the location of a neoplasm is necessarily a surgical and pathological task but, as more information becomes available from studies of both resectable and non-resectable lung cancer, important correlations with the above mentioned biological factors will be facilitated. A step in this direction has been made by Nohl (3), who has presented data supporting the impression that the site of the primary tumor is of prognostic significance.

Inadequate data can distort a clinical pattern, of course. In one patient a skeletal survey taken before a proposed pneumonectomy may show a small bone metastasis; the pattern is interpreted as disseminated lung cancer and the lung is not removed. In the same patient, however, if a skeletal survey were improperly interpreted or were not taken,

the lung would be removed, and a bone lesion discovered eight months later would be interpreted as late dissemination. Complications may interrupt a pattern before it is adequately developed; thus a patient may die of a pulmonary hemorrhage because of the strategic location of a small cancer.

Each life-history chart has been interpreted on a simple form (Figs. 6 and 8), starting with the *apparent clinical onset* of the disease. Lines have been drawn to indicate the progression of the cancer in each organ. These lines are schematic and are based in part on the apparent rate of tumor growth and on the disturbance produced in the function of the involved organ. They are arbitrarily drawn, because there are no quantitative data on the rates of tumor growth; these estimates of cancer progression are derived from clinical observation, x-ray examination, and laboratory studies. Another criterion is an estimate of the patient's *performance status* at frequent intervals (4). The performance status is a measure, in per cent, of ability to carry out normal life activities. It ranges from 100 in the absence of any impaired function to 0 at death. This criterion may be more critical and exacting than many others which measure tumor regression (5).

The patterns on our 80 patients have been compared and sorted. Figures 6 and 8 represent two of these. Three distinctive clinical patterns seem to be present. These are not entirely separate, however, in all cases, and there may be some overlapping. No statistical or prognostic conclusions can be drawn at present from our limited data; these can be attempted later on data obtained by the prospective studies, where the location of the primary tumor, rate of tumor growth, and interpretation of the pattern of metastases may be relevant to prognosis. While treatment may influence the expression of a pattern, the patterns being proposed are sufficiently general to accommodate the effects of most forms of non-curative therapy which may be employed.

*Type 1. Clinically Localized:* This type of cancer tends to grow and extend within the lung, with no evidence of peripheral metastases, at least until the terminal stage of the disease. These patients are the candidates for surgery. If the cancer is not resectable or the patient is adverse to surgery, the disease may be temporarily relieved or controlled by x-ray therapy. The localized form of lung cancer is not necessarily of the slow-growing variety; a local cancer may grow rapidly. If it becomes possible to estimate the rate of local tumor growth, a statistically valid prognosis for a group of patients with the same pattern may be established. Patients in this group may show late evidence of metastases, but these, in themselves, are rarely the cause of death. Performance status tends to remain high until shortly before death, presumably because of the absence of extensive systemic disease. Of the 80 cases, 30 were classified in this group.

*Type 2. Clinically Early Generalized Dissemination:* This type of cancer produces early evidence of distant metastases, often occurring before or simultaneously with pulmonary symptoms. Early in the clinical course of the disease, the patients may show evidence of involvement of peripheral nodes, bone, skin, liver, brain, and occasionally other tissues. Clinical signs may be particularly evident in certain organs, such as the brain or liver, but the important point is that this cancer grows rapidly in all parts of the body from the time of clinical onset. Usually the survival time is short, often less than six months from the clinical onset. There were 28 cases in this group.

*Type 3. Organ-Specific Distant Metastases:* There are subsidiary patterns of metastasis, in which the cancer seems to grow particularly well in distant specific organs. These secondary lesions may occur early and represent the initial complaint. During the major portion of its course the disease may appear to be confined to the lung and to certain organ systems, although more generalized me-

tastases may appear late or be found at autopsy. The principal types are:

*Variant A. Cerebral type:* The brain may be principally involved, and if the cerebral metastases are controlled, further progression of the disease may not become manifest for many months. There were 10 cases in this group.

*Variant B. Bone type:* The cancer may proliferate in bone and involve large areas of the skeleton. Hypercalcemia, pathologic fractures, and bone marrow replacement by cancer may result. There were 7 cases in this group.

*Variant C. Hepatic type:* Massive hepatic metastasis may be the predominant manifestation of the disease, and hepatic insufficiency may be the cause of death. There were 5 cases in this group.

The clinical types of lung cancer suggested here must be confirmed by careful prospective case analysis, and from this study certain features of prognostic significance may emerge for each type.

#### SUMMARY

Methods have been described for collecting and recording data on the evolution of cancer in man. A tentative classification of the clinical patterns of lung cancer has been suggested, which now must be confirmed and possibly established on a statistical basis by prospective studies. These are in progress. Despite the obvious obstacles presented by the many factors which may influence the behavior of cancer, a vigorous attempt to define clinical patterns is justified.

These patterns will be useful in teaching the clinical behavior of cancer. They emphasize a clinical classification on the basis

of the biological behavior of the disease, as contrasted to a histologic classification or one based on postmortem findings.

The development of a usable classification of the several patterns of lung cancer can contribute to studies evaluating the effect of various forms of therapy. The selection of patients with the same biological characteristics will facilitate comparative studies of the effectiveness of different therapeutic agents. This is particularly pertinent because of the current interest in the comparative evaluation of potential chemotherapeutic agents.

Also, if acceptable patterns are evolved, they may be utilized to demonstrate a patient's clinical status and disease pattern in a simple, graphic manner at the moment that treatment is begun. On a time scale the pattern and apparent rate of progression of the cancer in various involved sites can be shown, together with the patient's performance status.

444 E. 68th St.  
New York 21, N. Y.

#### REFERENCES

1. KARNOFSKY, D. A., AND GOLBEY, R. B.: Design for Experimental Chemotherapeutic Studies. I. Natural History of Cancer. In Proceedings of the Third National Cancer Conference, 1956. Philadelphia, J. B. Lippincott Co., 1957, pp. 428-435.
2. RIGLER, L. G., O'LOUGHLIN, B. J., AND TUCKER, R. C.: The Duration of Carcinoma of the Lung. *Dis. Chest* 23: 50-71, January 1953.
3. NOHL, H. C.: An Investigation into the Lymphatic and Vascular Spread of Carcinoma of the Bronchus. *Thorax* 11: 172-185, September 1956.
4. KARNOFSKY, D. A., ABELMANN, W. H., CRAVER, L. F., AND BURCHENAL, J. H.: Use of Nitrogen Mustards in the Palliative Treatment of Carcinoma with Particular Reference to Bronchogenic Carcinoma. *Cancer* 1: 634-656, November 1948.
5. GELLHORN, A.: Objective Criteria in Therapeutic Evaluations. In Proceedings of the Third National Cancer Conference, 1956. Philadelphia, J. B. Lippincott Co., 1957, pp. 436-442.

#### SUMMARIO IN INTERLINGUA

##### Studios Preliminar in Re le Historia Natural de Cancere Pulmonar

Isto es un reporto del tentativa, nunc progredente al Centro Memorial de New York, de disveloppas schemas characteristic de crescentia e comportamento de varie formas de cancro human integremente super le base de observationes clinic.

Pro iste objectivo, un forma special de dossier es mantenite pro le patientes individual ab le tempore de lor hospitalisation usque al dimission o al morte. Le dossier include un detaliate formulario catalogic in que le historia medical del

paciente es indicate per informationes non solamente positive sed etiam negative, un succincte folio de admission, un folio de dimission que summarisa le tractamento e le responsa del paciente e etiam le diagnose al dimission o—in caso de morte—le immediate causa mortal insimul con le eventos terminal, un summario autoptic, e pro omne paciente visitante un notitiario que permette sequer le manifestationes clinic del cancro e le stato del paciente.

Pro un gruppo seligite de pacientes un synoptic historia vital es elaborate que monstra chronologicamente le evenimentos successive in le curso del morbo.

Un classification tentative del schema clinic de cancro pulmonar ha essite derivate retrospectivamente, sed isto attende

confirmation statistic super le base de documentation del typo describe. Le sequente cinque categorias es recognoscite: Clinicamente (1) localisate o (2) con precoce dissemination generalisate, e metastases organo-specific de typos (3) cerebral, (4) ossee, e (5) hepatic.

Es exprime le conviction que le elaboration de un usabile classification del varie schemas de cancro pulmonar va esser de adjuta in explicar al studentes le comportamento clinic de cancro, va contribuir al evaluation del varie formas de therapia, e va demonstrar simple e graphicamente le stato clinic del paciente quando le tractamento es initiate e etiam le progresso que le morbo attinge in le varie situs afficite per illo.





# Roentgen Therapy of Carcinoma of the Lung<sup>1</sup>

FRANZ BUSCHKE, M.D.

I HAVE BEEN ASKED to discuss what I regard as "reasonable indications for and contraindications to radiation therapy of bronchial cancer," and what I "believe to be a practical palliative technic as well as a radical technic."

The following conclusions in response to these specific questions are based on experiences with the treatment of bronchocarcinoma at the Swedish Hospital, in Seattle, since 1939. The material is small but I believe permits certain conclusions in regard to future policy.

Between 1939 and December 1953 we saw a total of only 130 cases (Table I). Of these, 49 per cent were rejected; 40 patients (30 per cent) received what we considered adequate radiation therapy to the primary lesion and/or mediastinum. Because of our depressing experiences, we purposely discouraged referral for radiotherapy, which explains the small number of cases.

In January 1954, when our 2-MEV machine began operating, I decided to make another attempt with a selected group of patients. All of these I selected and treated personally throughout their entire course of therapy. They were chosen for specific clinical indications and were treated by technics adjusted to the specific purpose to be accomplished. In the ensuing nineteen months, 70 patients were seen, of whom 33, or 47 per cent, received complete treatment of their intrathoracic disease. Twenty-six patients (35 per cent) were refused treatment for various reasons, mainly because of the absence of particular symptoms which would have been benefited by any form of radiation therapy or because it was contraindicated by the general condition.

On the basis of this rather small but well controlled material, I would propose

TABLE I: BRONCHOGENIC CARCINOMA, SWEDISH HOSPITAL, 1939-1955

	1939-1953	January 1954-July 1955
Patients seen	130	70
Not treated	64 (49%)	26 (35%)
Treated for extra-thoracic disease	14 (10%)	10 (14%)
Incomplete treatment to chest	12 (9%)	1 (1.4%)
Complete treatment	40 (30%)	33 (47%)

the following considerations as a guide for more extensive investigation.

In the first place, it is essential to recognize that there are two chief clinical forms of carcinoma of the lung, which can be separated from the point of view of the biological behavior of the disease, symptomatology associated with this behavior, and therapeutic possibilities.

The *first group* comprises the undifferentiated carcinomas, which include both the so-called oat-cell and the small-cell carcinomas. These tumors behave clinically almost like lymphoblastomas, with rapid progression through the pulmonary parenchyma and regional lymphatics, and early and widespread dissemination. Some outstanding thoracic surgeons recognize that, if the histologic diagnosis of tumors of this type can be made preoperatively, they are unsuitable for surgery because of their biological character and should not even be explored. Because of their rapid progression, they are likewise usually not controllable by radiation, in spite of the easy local response, but some of their symptoms can be well palliated by judicious radiotherapy. Not infrequently these tumors produce extensive, rather rapidly progressing mediastinal disease with mediastinal embarrassment, and at times they are a source of major bleeding. It is these symptoms that represent the main indications for radiation therapy.

<sup>1</sup> From the Tumor Institute, Swedish Hospital, Seattle, Wash. Presented as part of a Symposium on Treatment of Bronchial Cancer, at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2-7, 1956.

Very occasionally, it seems possible to control the disease, as is evidenced by one case reported by Schärer. I saw this patient in 1953, eleven years after treatment in Zürich by 180-kv roentgen irradiation. This is, of course, a most unusual observation and cannot influence our indications for therapy.

With this type of tumor, if treatment is given for the relief of mediastinal symptoms or hemorrhage, a moderate dose—around 3,000 to 4,000 r in about thirty days—should be delivered to the mediastinum through relatively large fields. The disease usually progresses rapidly elsewhere, either shortly after treatment or even while treatment is in progress, but the most distressing obstructive symptoms can be temporarily relieved.

The *second group* of lung cancers comprises the epidermoid carcinomas and the adenocarcinomas originating in the bronchial mucosa. I believe that in radioresponse and character of the disease these two types are sufficiently similar not to justify a differentiation in this discussion. We know from Rigler's studies that these tumors progress very slowly over many years and, if they are found in the presymptomatic stage, are unquestionably surgical problems. Their submucosal and peribronchial progression, however, leads to clinical symptoms—mainly due to bronchial obstruction—usually at a time when surgical removal is not possible, either because of local fixation to mediastinal structures or because of mediastinal node involvement. For the same reason, they are, of course, not then amenable to curative roentgen therapy in general, though I may mention, as curiosities rather than as guides for indication, a few cases of permanent control by radiation therapy recorded in the literature. Smithers reported 6 cases which had passed the five-year limit from a group of 171 that were completely treated. Windeyer has achieved 4 six-year controls in over 200 cases. It is incidentally interesting to know that all these cases of bronchogenic carcinoma with apparently permanent con-

trol following radiation therapy were treated with either 400- or 200-kv radiation, which again indicates that the disease itself is more important for the outcome than the quality of rays or the machine used.

In this group of more slowly progressing and less radioresponsive carcinomas, mediastinal embarrassment usually does not occur, probably because the progression of mediastinal node involvement is not sufficiently rapid and other complications terminate the issue before large masses develop in the mediastinum, even though node metastases are commonly found on exploration or at autopsy.

The indications in these cases depend on the particular symptoms at the time when the lesion is found to be inoperable: bronchial obstruction, cough, gross hemorrhage. The main indication for palliative radiotherapy is to reopen the obstructed bronchus and to prevent or postpone the complications secondary to the obstruction. This is possible in a number of instances. Usually, however, at least with the technic so far used, the result is short-lived. After four to six months the bronchus will again be obstructed. The patient will pass through the same sequence of misery, so that in many of these cases, even if temporary results are accomplished, the real value of the procedure appears to me somewhat doubtful, since the mechanism of dying is not altered.

Because these tumors require a higher dose, they cannot be treated through as large fields as the first group. I have attempted in these instances to localize the treatment carefully to the obstructed bronchus, as demonstrated either by bronchoscopy or on exploration. Our thoracic surgeons have been most co-operative, placing metal clips at what they considered the center of the lesion if they found the case inoperable and anticipated this form of subsequent radiation therapy, or introducing metal seeds through the bronchoscope at the time of bronchoscopy. This facilitates accurate centering and permits us to limit the fields to about 8 or 9 cm.

TABLE II: BRONCHOGENIC CARCINOMA, SWEDISH HOSPITAL, JANUARY 1954-JULY 1955

Histology	No. treated	Alive more than 6 months after treatment	Alive more than 12 months after treatment	Palliation more than 3 months after treatment
Undifferentiated (oat-cell and small-cell)	10	2	0	4
Epidermoid carcinoma	11		3	3
Adenocarcinoma	5	3	0	1
Carcinoma	4	1	0	2
	—			
No positive biopsy	30		2	
	3			

diameter. In this fashion we have delivered 6,000 r to the lesion over a period varying between forty-five and sixty days, depending on the patient's tolerance.

I had hoped, when I started this particular study, to obtain some cases in which a relatively small lesion without demonstrable lymphatic extension was found to be inoperable because of local anatomical reasons and where, therefore, an attempt at more than temporary palliation was justified. I encountered only 1 case of this kind, with no mediastinal involvement on exploration, but I succeeded only temporarily and the patient died of progressing disease after fifteen months. It is possible that in occasional instances of this kind we should now carry the dose considerably higher (8,000-10,000 r), but cases of this type are rare. Obviously, in the presence of disease beyond a volume that can be covered by a small field, any attempt to increase the dose would be futile and harmful. Whether, in cases of apparently satisfactory complete removal, prophylactic postoperative radiation therapy to the mediastinum in the absence of grossly demonstrable mediastinal adenopathy is indicated, I do not know. I have treated only 1 such patient, on the assumption that minimal node involvement which does not interfere with the blood supply of the lymph nodes may possibly be controlled or retarded in its progression by fibrosis. This patient so far is in good condition fourteen months after therapy.

Frankly, I do not believe that much can be concluded from an analysis of survival time even though in some reports it appears that life is occasionally prolonged for

a few months. I can only state that, in retrospect, it seems from our experience that in many instances a survival of three to four months following a two-months course of massive radiation therapy hardly justifies the procedure, and that in every case a careful appraisal of the possibly anticipated result, with careful evaluation of the relative discomfort caused by the disease and by the treatment, is necessary.

From an analysis of our small group (Table II) it appears that palliation lasting for more than three months is rare in the epidermoid and adenocarcinoma groups following a much more massive treatment than is given in the undifferentiated group, where in view of the sometimes alarming mediastinal symptoms even a short palliative effect must be considered as a justification for therapy.

Summarizing then, I would state the policy which I intend to follow in the future about as follows:

1. Undifferentiated carcinoma of the lung should be treated if marked symptoms due to mediastinal embarrassment or gross hemorrhage are present. The field should cover the entire mediastinum with a moderate dose—about 3,000 to 4,000 r—in mid-chest. Whether the field should cover additional pulmonary areas which are considered the primary source of the disease should depend on the individual situation.

2. Epidermoid carcinoma and adenocarcinoma should be considered for radiation therapy only if found inoperable either prior to or at the time of exploration, for the effect on specific symptoms which are either present or anticipated in the near future, and if the anticipated life

expectancy from the point of view of general condition and demonstrable extent of the disease is long enough to justify such a major procedure.

3. With the exception of Pancoast tumors with infiltration of the brachial plexus, thoracic pain secondary to carcinoma of the lung is usually due to involvement of sympathetic structures and, in my experience, is seldom benefited by radiation therapy. We have found that the at times severe but ill-defined pain throughout the chest is better relieved by sympathetic nerve block.

4. Palliative radiation therapy of carcinoma of the lung should be considered only for specific symptoms and the technique should be adjusted accordingly. Palliative therapy means therapy with the intent of palliation and not injudicious therapy of surgically uncontrollable disease.

5. With the exception of the most urgent indication for therapy on account of massive mediastinal embarrassment, radiation therapy for carcinoma of the lung should not be given in the absence of unequivocal histologic proof of the diagnosis. Other pulmonary conditions which may closely imitate bronchial carcinoma clinically and radiologically are severely and at times fatally aggravated by the added damage of as massive an irradiation as is necessary if a result of even temporary nature is to be expected in the presence

of carcinoma. It is unreasonable to submit a patient to this risk in view of the at best unsatisfactory effect upon carcinoma. I believe, from observations of the clinical course, that 2 of our patients treated without histologic proof and surviving for twenty-seven and eighteen months, respectively, may belong in this group.

6. In regard to the unavoidable question of the advantages of supervoltage therapy in any form, I would state that, because of the better tolerance of this radiation, with reduced morbidity due to the treatment itself, the greater ease of delivering adequate doses in the depth of the chest, and the possibility of more accurate localization of the beam through the better defined smaller volume, we are justified in accepting for palliative treatment patients whom we would refuse medium-volt therapy because of the greater morbidity, which would at times be out of proportion to the possible palliative result. Otherwise, I believe, the use of supervoltage does not in clinically significant degree change the so far bleak picture of radiological therapy for carcinoma of the lung.

University of California Medical Center  
San Francisco 22, Calif.

#### REFERENCES

- SCHÄRER, K.: Die Strahlenbehandlung des Bronchuskarzinoms; Zürcher Erfahrungen. *Oncologia* 4: 65-93, 1951.  
SMITHERS, D. W.: Facts and Fancies about Cancer of the Lung. *Brit. M. J.* 1: 1235-1239, June 6, 1953.  
WINDEYER, B.: Personal communication.

#### SUMMARIO IN INTERLINGUA

##### Radiotherapia pro Carcinoma Pulmonar

Iste reporto es basate super observationes in 33 patients qui recipeva un complete curso therapeutic pro carcinoma pulmonar per medio de un radiation de 2 MEV.

Ab le puncto de vista del possibilitates therapeutic, duo gruppos de tumores pulmonar existe. In le gruppo non-differentiate, que include carcinomas a cellulas aveniforme e carcinomas a parve cellulas, le progresso del tumor es rapide e general-

mente non bridabile per chirurgia o per radiation. Nonobstante, in tal casos radiotherapia pote esser usate pro alleviar le symptommas mediastinal e le hemorrhagias, sed il non es probabile que le resultado final es alterate per iste mesuras.

Le carcinomas epidermoide e le adenocarcinomas progrede lentamente, e in lor prime phases illos es problemas chirurgic. Le indicationes pro radiotherapia in iste gruppo depende del symptommas par-

ticular que es presente quando il es constatate que le lesion non es operabile: obstruction bronchial, tusse, e hemorrhagia grossier. Le objectifo principal del irradiation palliative es re-aperir le broncho obstruite e prevenir o retardar le complicationes que es secundari al obstruction. Le alleviamento, nonobstante, es usualmente temporari, e frequentemente le justification del tractamento es dubitose.

Radiation palliative deberea esser prenite in consideration solmente como mesura contra symptomatas specific, e le technica debe esser modificate correspondentemente. Le prova histologic del diagnose es indispensable.

Quanto al uso de supervoltages, le autor opina que le meliorate tolerantia pro iste forma de radiation, le reduce morbiditate resultante de su uso, le plus grande facilitate de portar doses adequate al profundor del thorace, e le possibilitate de un plus accurate localisation del fasce a transverso un minus extense e melio definite volumine de histos justifica nos a extender lo—i.e. le uso de supervoltages—al tractamento palliative de pacientes qui possibilmente non eserea acceptate pro therapia a voltage intermediari. A parte isto, le supervoltages non effectua un clinicamente significative grado de alteration in le currentemente triste prospecto del therapia radiologic pro carcinoma pulmonar.





# The Results of Radiotherapy in Cancer of the Lung<sup>1</sup>

MILFORD D. SCHULZ, M.D.

MY PART IN THIS symposium on cancer of the lung has to do with survival of patients treated by radiotherapy. This I propose to fulfill by presenting, *en grosse*, material which we have seen at the Massachusetts General Hospital during the period extending from 1940 to 1953. During this period we have recorded on our register 772 patients with histologically proved cancer of the lung. All patients have been followed to death or are known to be alive.

One hundred and forty-eight patients, or 19 per cent of the total number, for one reason or another received no treatment at all; 385 or 50 per cent received only x-ray treatment. This latter group includes all patients in whom operation amounted to no more than a biopsy, as well as those who were deemed unsuitable for any surgery at all. It will be recognized that this represents a group which is essentially incurable at the onset.

All patients in whom the disease was localized and resectable, who were in good enough physical condition to withstand surgery—with the exception, in later years, of those with oat-cell cancer—were treated surgically. Twenty-one per cent of all patients seen, or 163, were so treated. This represents a group of potentially curable lesions. Seventy-six or 10 per cent of the series were treated by surgery followed by irradiation. This was done for one of two reasons; in a few instances for late recurrence in the chest after a period of freedom from the disease following surgery; more commonly, immediately following incomplete removal of the tumor because of extension to the chest wall, pericardium, diaphragm, lymph nodes, or other mediastinal structures.

This material, though obviously biased in favor of a surgical approach, is probably

TABLE I: SURVIVAL OF 772 PATIENTS WITH CANCER OF THE LUNG, MASSACHUSETTS GENERAL HOSPITAL, 1940-1953

Survival Period (mos.)	Treated by Surgery Alone (163 patients)	Treated by Surgery and X-rays (76 patients)	Treated by X-rays alone (385 patients)	No Treatment (148 patients)
6	96 (58%)	54 (71%)	137 (35%)	25 (17%)
12	80 (49%)	38 (50%)	57 (15%)	4 (3%)
24	63 (38%)	21 (27%)	17 (5%)	
36	55 (34%)	6 (8%)	11 (3%)	
48	39 (24%)	4 (5%)	5 (1%)	
60	27 (17%)	3 (4%)	4 (1%)	
M.S.T.	12 mos.	12 mos.	4 mos.	3 mos.

representative of what is seen in most clinics where, as in ours, the attitude is that operation is the treatment of choice when applicable to those having a possibility of cure. An evaluation of our results may then be taken as a fair estimate of what can be done by radiotherapy in the group of patients which most of us see. It must not, however, be taken as a critical evaluation of the potentialities of radiotherapy in lieu of surgery.

Of those treated by radiotherapy alone—and this of course represents a motley group, no attempt having been made at subclassification—all but 35 per cent were dead within six months after the beginning of treatment, all but 15 per cent in one year, and all but 5 per cent in two. There were a sturdy 4, or 1 per cent, who continued to survive more than five years after treatment, and some of these at least were apparently cured of the disease for which they were treated. More about them later.

The calculated median survival time of this entire group is only four months, which is practically the same as that of those who received no treatment at all, where the calculated median survival time was on the order of three months. Even if one dis-

<sup>1</sup> From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Presented as part of a Symposium on Treatment of Bronchial Cancer, at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2-7, 1956.

cards the frightful attrition of the first six months, there is still a survival of only 17 in 137, or 12.5 per cent, one and one-half years later. If, however, the patient managed to survive three years following radiotherapy, it would seem that his disease was of such a nature as to give him about one chance in three of making the five-year mark, a chance approaching that with surgery at a comparable time period, about one in two.

The survival of those in whom radiotherapy was given following surgery because of persistent or, in a few instances, because of recurrent disease is somewhat more encouraging; 50 per cent were alive in one year, which is essentially the same figure as for surgery. Even at two years after radiotherapy to residual cancer, survival does not fall far behind that of surgery alone—27 compared to 38 per cent. Between two and three years, however, results are far less favorable than those of surgery alone, 8 vs. 34 per cent. If, however, a person irradiated postoperatively manages to survive three years it is interesting to note that his chance of arriving at five years, in our material at least, was 50 per cent—3 in 6—which is essentially what the three-year survivor following surgery without irradiation might expect—27 in 50. We must, of course, recognize the statistical insignificance of numbers as small as these. In both the surgical group and that treated by radiotherapy following unsuccessful surgery, the median survival time was calculated to be twelve months or about three times that which is to be expected for the group treated by radiotherapy alone, or for those receiving no treatment at all.

If one plots the data graphically (Fig. 1), some interesting—though perhaps unreal—observations can be made. For all patients *not* treated solely by surgery the decay curve is considerably steeper than for those thus treated, which is what one would expect from the nature of the disease. After three years, however, the slope of the curve for those treated by surgery alone changes and becomes essentially that of

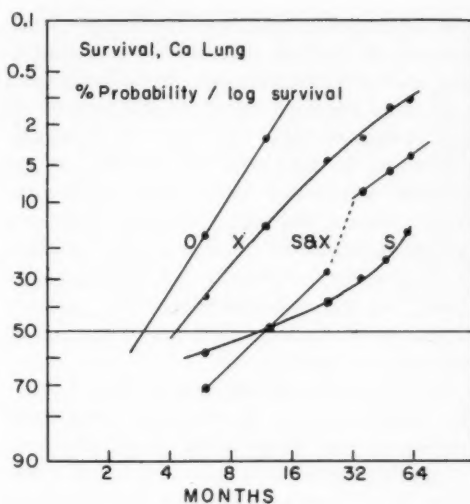


Figure 1

those surviving treatment by radiotherapy, either alone or following inadequate operation. This would indicate that, as has been said by others, cancer of the lung is in fact a biologically determinable disease and that treatment alters only the early picture.

Probably because of the nature of the disease or the small size of the group, we found no significant improvement in the length of survival following excessively large tumor doses. The net survival of 3 per cent at three years, of all patients treated with x-rays, is essentially that which has been reported by Smithers from the Royal Cancer Hospital and by others after so-called radical x-ray therapy. I do not doubt that doses in the order of 6,000 r in a month to six weeks are indicated in certain individuals, and that in a few selected cases these will be worthwhile. We have not yet been able to show, however, that the gross result has been improved by such high dosage. All of our long-term survivors received less than 4,500 r to the tumor.

An attempt has been made to determine whether the histologic type of the tumor has any bearing on the survival following irradiation. Nothing startling has been found except the slight though not

significant prolongation of life in those with oat-cell carcinoma. Recently, I was startled to see a man, now in his fourth year, well and healthy after radiotherapy to a carcinoma of this type. Another patient, a woman, is still without activity of an oat-cell carcinoma after more than four years. These patients are not included in the data shown on the chart. Defeat in this disease occurs not because the tumor is not radiosensitive—it is very much so—but because it metastasizes so early and so widely.

From these cold figures it would seem that radiotherapy of most patients with cancer of the lung is, to say the least, of modest value, and on the basis of these data alone one would be inclined—almost certainly—to avoid treatment of all but a highly selected few. There is, however, one very important fact which is not shown by these data, namely, what can often be done by way of palliation—relief of pain, cough, and blood spitting, and the prevention or resolution of that most distressing complication so often seen in this disease, superior mediastinal obstruction. These are the things which foster continuance of palliative radiotherapy in the management of carcinoma of the lung. These are the things which the figures do not show but which are very real to the individual patient, and which encourage us as clinicians. This is especially true of undifferentiated cancers of the lung which lead to an early death by widespread metastases. Here, in our experience, local pulmonary and mediastinal disease is almost invariably controlled, leaving the patient to die in greater comfort of more remote metastases at vital sites.

To point up what is not shown by mere figures—what can be done in the way of palliation and sometimes even cure in an individual case—and to emphasize the fact that, from the point of view of the patient, the overall picture is perhaps not the most important, I should like to present several case histories:

The first is that of a young man who in 1947, at the age of thirty-eight, had a right total pneumonectomy for an epidermoid carcinoma, Grade II, of the bronchus, with involvement of the mediastinal lymph nodes. He remained well for five years, until the Fall of 1952, when he returned to the hospital with obviously recurrent tumor in the chest, causing a severe superior mediastinal syndrome. He was treated with x-rays, receiving a tumor dose of 5,000 to 6,000 r to the upper mediastinum and to both supraclavicular areas, where there were palpable metastatic nodes. This dose was probably unnecessarily large. Prompt relief of superior mediastinal obstruction and other symptoms followed. The patient remained well and was able to carry on his daily work for a period of two years thereafter.

The next case is that of a man with a superior sulcus tumor, which I believe we all accept as being unfavorable. This patient, following irradiation of only about 4,000 r given in three weeks, experienced almost complete relief of pain. Though the tumor later progressed slowly, he carried on his normal activity, working every day for more than two and a half years. He then experienced recurrence of pain, deteriorated rapidly, and died. I believe, however, that you will agree that for both of these men treatment was thoroughly worthwhile.

The next patient, a man of sixty-one, survived for more than five years and apparently was cured of his disease by radiotherapy. He was first seen in 1944 with a history of pain, cough, hoarseness, and hemoptysis for two and a half months. Roentgen studies of the chest revealed a tumor in the left lung root, with extensive mediastinal adenopathy. Biopsy of a supraclavicular node was reported as epidermoid carcinoma. Bronchoscopy showed the left bronchus fixed by tumor, but no mass was visible for biopsy. Because of these findings the case was deemed inoperable, and x-ray treatment alone was given. Following a tumor dose of 3,000 r

there was prompt remission of symptoms with dramatic regression of the tumor. Six years later the patient remained well and reported that he was working ten hours a day and felt better than he had felt in twenty-five years. In 1951, however, we received a letter from another hospital indicating that this man had entered with recurrent malignant disease. He was presumed to have died, but this presumption was incorrect, for in 1955 I was present at his postmortem examination at Pondville State Hospital, where he had died of malignant disease, not of the lung but of the larynx. The lungs and mediastinum showed no evidence of bronchogenic carcinoma.

Another case is that of a man who was apparently cured of one lung tumor but died of another more than ten years later. He was first seen in September 1942, at the age of fifty-seven, because of a consolidating process in the right lower lobe, which on bronchoscopy was found to be due to an obstructing tumor arising in the right main stem bronchus. Biopsy showed it to be an epidermoid carcinoma, Grade IV. X-ray therapy alone was given. This was done without benefit of supervoltage, and a tumor dose of no more than 3,000 r was delivered. Following treatment, cough and hemoptysis stopped. The lung cleared and the patient remained well until 1950, when, because of persistent sore throat, he returned. Examination showed a new tumor involving the right anterior pillar and tonsil. This proved to be an epidermoid carcinoma, Grade II. It also was treated with radiotherapy but with not quite the same success, for two years later it recurred in the soft palate, which was then resected. There was still no recurrence in the chest. Late in 1952 cough and fever developed and a chest film showed what was thought to be an abscess of the left lung. This was explained on the basis of aspiration because of absence of the palate. The patient failed to respond to appropriate manage-

ment, however, and bronchoscopy disclosed a new tumor in the left lower lobe bronchus. The main stem bronchus was clear, and the right bronchus showed no evidence of disease. An attempt was made to treat the new tumor by x-rays but within a month a fatal pulmonary hemorrhage occurred. Autopsy showed an apparently new cancer involving the left lung. There was no evidence of tumor at the site of the lesion in the right lung for which treatment had been given ten years before.

One more case, extraordinary in my experience, shows what can be done for an oat-cell carcinoma when it is treated before metastasis has occurred. The patient was a fifty-two-year-old man who in August of 1953 was referred to the hospital because of increasing shortness of breath of three months duration, cough with hemoptysis and pain in the right anterior chest, general malaise, and a weight loss of 7 pounds. Physical examination showed right hydrothorax, and 1,500 c.c. of clear fluid was removed from the right pleural space. This contained no tumor cells. Chest films showed fluid in the right pleural space and a mass in the right middle lobe, with limitation of motion of the right leaf of the diaphragm. Bronchoscopic examination was unsatisfactory. Papanicolaou smears were negative. Thoracotomy was performed and a mass in the right middle and upper lobes was found. This was inoperable because of invasion of the pericardium. Biopsy specimens from the tumor, the pericardium, the pleura, and from random sites in the right lung, all showed oat-cell carcinoma. Radiotherapy to the entire right chest, including the mediastinum, was given for a dose of 3,300 r to the mid-plane in thirty days. The patient remained well thereafter until June 1954, when a left supraclavicular mass developed. This was presumed to be metastatic tumor and was treated with 2,000 r in seven days. There has been no evidence of recurrent tumor since that time, and the patient has re-



mained asymptomatic. He is able to carry on his work as a painter, goes fishing for striped bass whenever he has a chance, and last winter shot his biggest buck. Despite statistical evidence that radio-

therapy is of limited value in instances such as this, this man feels that his treatment was very much worthwhile.

Massachusetts General Hospital  
Boston 14, Mass.

#### SUMMARY IN INTERLINGUA

##### Le Resultatos de Radiotherapia in Cancere Pulmнар

Le presente reporto se basa super le historia de 772 patientes con cancro pulmonar vidite al Hospital General Massachusetts inter 1940 e 1943. De illes, 148 (19 pro cento) recipeva nulle tractamento, 385 (50 pro cento) esseva tractate solmente per radios X, 163 (21 pro cento) esseva tractate solmente per chirurgia, e 76 (10 pro cento) esseva tractate per chirurgia e irradiation postoperatori.

Del patientes tractate solmente per radios X, 35 pro cento esseva morte intra sex menses, 85 pro cento intra un anno, e 95 pro cento intra duo annos. Solmente 4 superviveva cinque annos. Le periodo median del superviventia non esseva multo superior a illo del gruppo sin tractamento: quatro menses in comparison con tres.

Le cifras pro le patientes qui recipeva radiotherapia post chirurgia es alique plus

incoraggiante. Cinquanta pro cento superviveva un anno e 27 pro cento duo annos. Le correspondent cifras in le gruppo a chirurgia solmente esseva 49 e 38 pro cento. Post duo annos, le cifras pro chirurgia solmente esseva multo melior que illos pro le therapia combinate. Le periodo median de superviventia esseva le mesme in le duo gruppos: dece-duo menses.

Super le base de iste cifras il pare que radiotherapia in le majoritate del casos de cancro pulmonar es de modeste valor (pro exprimer lo clementemente), sed iste constatation ignora le effectos palliative: le alleviamento de dolor, de tusse, e de expectoration sanguinee e le prevention o resolution de obstructions mediastinal. Es presentate casos individual pro illustrar le responsas mentionate.





# Present Status of Chemotherapy of Bronchial Cancer<sup>1</sup>

BERNARD ROSWIT, M.D.<sup>2</sup>

NEARLY ALL PATIENTS with cancer of the bronchus sooner or later present problems in management of advanced and generalized neoplastic disease. So long as effective palliative agents (radiological and chemical) are at hand, these persons should never be regarded as "hopeless." They are entitled to the same basic medical and humanitarian considerations as patients with other chronic and disabling diseases.

Among the cancer-inhibiting drugs which have become clinically available in the past ten years, only the polyfunctional alkylating compounds seem to have any influence on primary lung cancer. This effect is non-specific, depending upon the remarkable affinity of these highly reactive compounds for any rapidly proliferating tissue. Nitrogen mustard ( $\text{HN}_2$ ) (methylbis betachloroethyl amine hydrochloride) was one of the first and remains one of the best of the mustard congeners to be utilized clinically by intravenous, intra-arterial and intrapleural routes. TEM (triethylene melamine), given orally, and Thiotepe (triethylene thiophosphoramidate), given by many routes, provide more limited effects and less consistent benefits. They have largely been abandoned in the management of this disease. Of more recent origin, Myleran (1,4-dimethane sulfonyloxybutane) and Nonane (1,9-dimethane sulfonyloxynonane) may become excellent oral substitutes for intravenous  $\text{HN}_2$ .

It is a frustrating fact that, in carcinoma of the bronchus, there appears to be no single distinctive biochemical abnormality, hormonal dependence, or special functional property that can be seized upon and manipulated for total destruction of the tumor without hazard to the human host. In the face of an ominous rise in incidence

and a dismal surgical cure rate, it is not surprising that this tumor, among several others, has become the target of a nationwide study in experimental cancer chemotherapy, sponsored by the Committee on Cancer Chemotherapy of the National Advisory Cancer Council. Thousands of new chemical agents are being prepared by biochemists and screened by biologists in animal subjects. The most promising of these drugs will then be investigated, under the most critical of experimental conditions. Our institution, among many other government and private hospitals, is actively engaged in this project. For 1957, the U. S. Congress has set aside twenty million dollars for this effort. Reports of progress will be presented at appropriate periods during the investigation.

In this paper, we shall discuss the potentialities and limitations of the alkylating agents, the antimetabolites, the radiation sensitizers, and multicomination drug therapy.

## POLYFUNCTIONAL ALKYLATING AGENTS

*Nitrogen Mustard ( $\text{HN}_2$ ):* In our experience with more than 1,000 patients with inoperable lung cancer, radiation therapy has provided temporary relief from distress and disability in the majority of the cases thus treated. The period of relative comfort and usefulness was often extended, even when survival time was not significantly prolonged. When radiation therapy became unfeasible or ineffective in the inexorable course of the disease, we found  $\text{HN}_2$  to be the only truly helpful chemical agent, especially in anaplastic tumors (20, 28-31). Since 1947, we have employed this alkylating compound in more than 150 patients with widely generalized disease, radiation resistance (initial or

<sup>1</sup> Presented as part of a Symposium on the Treatment of Bronchial Cancer, at the Forty-second Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2-7, 1956.

<sup>2</sup> Chief, Radiotherapy Service, Veterans Administration Hospital, Bronx, N. Y.

acquired), exhaustion of radiation tolerance of skin or lung, intractable radiation sickness, and the superior vena cava obstruction syndrome. A full course of radiation therapy became possible in patients whose condition before  $\text{HN}_2$  treatment precluded any consideration for the use of more effective ionizing radiation.

*Subjective benefits*, observed in about two-thirds of the cases, consist in temporary relief from pain, cough, dyspnea, fever and hemoptysis. *Objective results*, seen in about one-third of the cases, include decrease in size of pulmonary and metastatic lesions, resorption of pleural fluid, re-aeration of atelectatic lung, decrease in neurological signs, and improvement of the superior vena caval obstructive phenomena. Remissions range in duration from one to seventeen weeks, averaging three and a half weeks, after a course of  $\text{HN}_2$ . This experience is supported by the cumulative reports of 14 other investigative groups, in which 134 of 254 cases responded favorably to the drug (28). The highly undifferentiated and oat-cell types are quite mustard-sensitive, but clinical response may also be observed in well differentiated epidermoid carcinomas and adenocarcinomas. The rare alveolar-cell tumors seem to be entirely resistant to this agent.

*Dose levels* of 0.4 mg. per kilogram of body weight per course are employed in one, two, or four fractions, injected directly into the tubing of a running infusion. This course should not be repeated in less than four weeks, to allow for complete recovery of the bone marrow.

Nitrogen mustard is a polyfunctional alkylating agent with a high degree of *toxicity* for the cytoplasm and nucleus of rapidly proliferating cells. It promptly inhibits a variety of cellular enzymes, interfering with such vital metabolic processes as cellular respiration. The pulmonary vascular bed is the first capillary bed traversed after intravenous injection, and hence a higher concentration of the drug is fixed in pulmonary tissues than in more peripheral areas. This may explain

the fact that bronchial cancer is the only epithelial tumor significantly affected by the intravenous injection of  $\text{HN}_2$ .

Because of its impact on the hematopoietic system, nitrogen mustard may produce pancytopenia after several courses. In patients with relatively normal bone marrow, a maximum drop in the white blood cell count is seen in the second or third week after treatment, with recovery in the fourth week. Should the bone marrow already be invaded by tumor or some other disease process, the probability of early and irrevocable damage is greater. The induction of nausea and vomiting by  $\text{HN}_2$  is well known; this begins within one-half to two hours after injection but is generally controlled by chlorpromazine or a sedative. Testicular atrophy (35) and psychosis (27) have been reported after use of the drug.

The histologic changes in normal tissues and in tumors after hyperintensive dosage are strikingly similar to those seen after the use of ionizing radiation (16, 35). Nevertheless, within tolerable dose limits,  $\text{HN}_2$  cannot destroy human cancer. It is not a *substitute* for definitive x-ray treatment in patients with limited intrathoracic lesions for whom there is a probability of extension of life by intensive irradiation. Radiation-induced remissions for *local* metastatic disease are far more lasting than those obtained with the chemical agent.

On the other hand, when the *superior vena cava obstruction syndrome* intervenes,  $\text{HN}_2$  is a convenient and expedient adjunct to employ as a prelude to radiation therapy. Such patients, suffering from the effects of mounting cerebrovascular pressure, are often in desperate need of the respite which  $\text{HN}_2$  provides, rapidly but briefly, to be followed by radiotherapy for more lasting benefit. In a comparative study of 38 cases made in our clinic (29), mustard remissions rarely lasted longer than three to eight weeks, while those induced by radiation (3,000 to 4,000 r Dn) may last as long as a year, averaging fourteen weeks. We recommend the prompt use of intra-

venous  $\text{HN}_2$ , 0.4 mg. per kilogram of body weight, followed in one week by x-ray treatment, supervoltage preferred, in daily tumor doses of 150 r until 3,000 to 4,000 r Dn has been delivered.

The only contraindications to  $\text{HN}_2$  are (a) situations where vomiting may lead to asphyxia in patients with severe edema of the mucosa of the upper respiratory tract and (b) extremely high cerebrovascular pressure, threatening hemorrhage if aggravated further by vomiting. We have treated many patients initially with x-ray therapy (dose levels 75 to 150 r Dn) and have never observed the mediastinal edema so often referred to in other reports.

*Pleural effusion* in bronchogenic carcinoma is frequent and distressing, yielding only infrequently to x-ray therapy alone. Radioactive colloidal suspensions, introduced into the pleural cavity, have been more helpful, controlling fluid in about 50 per cent of the cases.  $\text{CrP}^{32}\text{O}_4$  has been particularly useful in our clinic. These radioactive materials, however, are expensive, involve radiological hazards, and require special facilities which are not universally available. Treatment with intrapleural  $\text{HN}_2$  is less expensive and less hazardous; it is always available, requires no special facilities, and produces clinical benefits similar to those noted with  $\text{Au}^{198}$ ,  $\text{P}^{32}$ , or  $\text{Y}^{90}$ . This procedure was first reported by Karnofsky (11) and his colleagues, later by Weisberger (41) and his group.

After thoracentesis, 0.4 mg. of nitrogen mustard per kilogram of body weight in isotonic sodium chloride is introduced directly through the needle employed for drainage. The patient is required to change position every five or ten minutes for one hour to obtain more uniform distribution. One day after  $\text{HN}_2$  therapy, thoracentesis may be repeated and the pleural space aspirated dry. One occasionally sees a reactive exudation immediately after nitrogen-mustard therapy, with a rapid accumulation of fluid, but this is a favorable prognostic sign (41). There is generally only minimal pleural scarring,

but a true adhesive pleuritis with obliteration of the pleural space is sometimes encountered. Patients rarely have pain after the injection, and nausea and vomiting are minimal. Similarly, the leukopenia is mild and transitory. It has therefore been suggested by Weisberger *et al.* (41), that a larger dose be employed to accomplish longer remissions. His group recommends combined use of radioactive colloids and  $\text{HN}_2$ , for this method has yielded no failures in their hands. One cannot expect successful control of fluid when the effusion is due to obstructive phenomena and appears chylous in nature. In such cases, intrapleural therapy must be combined with x-ray treatment to the responsible tumor mass.

*Intraperitoneal* injection of  $\text{HN}_2$  can be usefully employed for control of intractable ascites arising from metastatic lung cancer in the abdomen. Paracentesis is performed in the usual manner and approximately one-half of the fluid is removed. The drug, in a dose of 0.4 mg./kg. in normal saline, is administered through a small catheter inserted into the trocar or through a No. 18 needle introduced at another site. As in intrapleural injections, the patient's position is shifted frequently for about one hour (41).

*Intrapericardial* injections are performed in a similar manner to control the rather infrequent complication of intractable effusion in this space.

The *intra-arterial* route for  $\text{HN}_2$  therapy has been explored by some workers (2, 14, 36, 37) to deliver the principal impact upon the tumor-bearing area while sparing the host. Klopp and his associates (14) introduced the drug directly into the arterial blood supply of tumors, producing regression in a variety of human neoplasms. Bierman and his group (2) also utilized this route and described measurable effects on malignant tumors in man. Severe injury to normal tissues within the field of treatment is one of the limiting factors in this method. Sullivan and his co-workers (36) described a simplified catheter technique, which they used in several patients,

including one with cerebral metastasis from bronchial cancer who failed to benefit from intravenous  $\text{HN}_2$  but did gain a remission from direct injection of the agent into the right carotid artery.

The outstanding limitation of the application of this method for intrathoracic lesions is the deplorable fact that the primary tumor and regional lymph nodes are nourished *via* the bronchial artery, and this vessel is surgically inaccessible. Klopp (14) has suggested that ligation of the efferent veins would extend the usefulness of arterial mustard by further increasing the intensity of the regional effect and diminishing systemic toxicity. Sullivan (37) has indeed closed the pulmonary vein from a specified lobe both temporarily and permanently, with the hope of establishing working collaterals *via* which the drug might reach the tumor more directly after injection of the particular branch of the pulmonary artery to the affected lobe. This technic is at present being applied to human subjects after preliminary experiments in dogs.

**Thiotepa:** Triethylenethiophosphoramide (Thiotepa) is less effective than  $\text{HN}_2$  in lung cancer, but it can be applied by a variety of methods, including the oral and interstitial. It is much more useful in breast cancer.

**TEM:** Triethylene melamine (TEM) has occasionally been used in generalized lung cancer because of its principal attribute—the possibility of oral administration without nausea and vomiting (3, 12, 32). This drug is not recommended, however, because of its inconsistent action, delayed effects, and unpredictable toxicity to the bone marrow in the individual case.

**Myleran:** Another oral alkylating agent, Myleran (1,4-dimethane sulfonyloxybutane), has been widely employed in many clinics, including our own, as a valuable drug in chronic myeloid leukemia (10). Employing short hyperintensive dosage schedules, Sullivan (38) has demonstrated that this *orally* administered agent can also be useful in bronchogenic carcinoma. He recommends doses of

1 mg./kg./day for four consecutive days to produce results comparable to those obtained with intravenous  $\text{HN}_2$  but longer delayed and without associated nausea and vomiting. The compound is given once daily by mouth, one hour before breakfast, in multiples of 25 mg.

Of 18 patients evaluated for antitumor activity of this preparation, 6 showed objective evidence of tumor regression, as indicated by decrease in size of measurable pulmonary lesions, decrease in high venous pressure associated with superior vena cava obstruction, improvement in abnormal neurologic signs due to cerebrospinal metastases, and decrease in hepatomegaly. The duration of the improvement was two weeks to three months. In 3 other cases, the benefits were symptomatic only.

In all patients treated, with a single exception, varying degrees of leukopenia developed, occurring between the twelfth and thirtieth days after the end of therapy, and abating by the twentieth to fifty-fourth day. In most instances the decrease in the hemoglobin and platelet values was slight and transient. In 1 case a persistent pancytopenia occurred. The compound was well received by all patients in the dosage schedule used and was lacking in other toxic effects, notably gastrointestinal.

**Nonane:** Miller (21) explored the antitumor action of the C-9 analogue of Myleran, called Nonane (1,9-dimethane sulfonyloxynonane). This drug was administered to patients with various malignant neoplasms, including bronchogenic carcinoma, and the preliminary results were nearly comparable with those observed with Myleran. Nonane is administered orally, once daily, one hour before breakfast, in doses of 20 mg./kg./day for four days. This schedule produced only a moderate and transient bone marrow depression.

#### ANTIMETABOLITES

Quantitative differences exist between normal and cancer cells characterized by lower concentrations of many enzymes and



metabolites in the tumors when compared to normal tissues. This fact has led to the concept of antimetabolite or anti-enzyme therapy, directed against these low levels, blocking the vital metabolic pathways of the malignant cell, with little or no effect on the identical metabolic routes of normal cells. The normal cells are protected by their higher concentration of the particular metabolite or enzyme. Anti-folic acid therapy in leukemia is an excellent example of this general approach to cancer chemotherapy.

*DON* (6-diazo-5-oxo-L-norleucine) was selected for preliminary clinical trial because it is a powerful glutamine antagonist structurally similar to azoserine but 10 to 100 times as active biologically as the latter. It was found to possess one of the widest *in-vivo* antitumor spectra of potential carcinostatic agents. Yet, when investigated clinically by Magill and his colleagues (18) in 37 patients with disseminated neoplastic disease, it was productive of no substantial therapeutic benefits. Furthermore, its toxic effects proved to be relatively severe, including mucosal ulcerations of the mouth, diarrhea, nausea and vomiting.

Many other antimetabolites, perhaps more productive, will surely come to hand for clinical testing as a result of the unique national research program in cancer chemotherapy sponsored by the National Advisory Cancer Council.

#### MULTI-COMBINATION CHEMOTHERAPY

Shapiro (33) suggests that the utilization of combinations of drugs may produce sufficient simultaneous damage to the metabolism of the cancer cells to result in their rapid death before drug dependence or drug resistance can develop. Laboratory studies on transplantable mammary adenocarcinoma of the mouse, utilizing 6-aminonicotinamide, desoxypyridoxine, 8-azoguanine, testosterone and other compounds, appear to support this concept (33). The extension of the study to clinical trials in patients with advanced carcinoma will be followed with keen interest.

#### RADIATION POTENTIATORS

As radiologists, our primary objective in the treatment of intrathoracic lesions is the total destruction of the neoplasm without severe or fatal radiation pneumonitis. The tolerance of the normal lung remains indeed the principal limiting factor to successful treatment in early cancer of the bronchus and esophagus. Current investigation of the potentiation of radiation effect on tumors by chemical methods therefore deserves our earnest attention, however small the gains, and despite the scant measure of success in similar studies in the past.

*Synkavit*: Mitchell and his group in England (22-24) have been studying for several years the influence of Synkavit (tetra-sodium 2-methyl-1,4 naphthohydroquinone diphosphate) and certain related compounds, as radiosensitizers when administered intravenously to patients receiving x-ray therapy for cancer of the bronchus. These investigations have demonstrated selective concentration of the drug in the tumor cells. Once inside the cell, it appears to react specifically with sulfhydryl compounds. Hence selective radiosensitization is envisaged as the converse of -SH protection against ionizing radiation.

Among patients with inoperable cancer of the bronchus (confined within the field of irradiation) receiving intravenous Synkavit, a small but definite improvement in survival time is reported. For 59 such cases, the mean survival was 9.5 months from the first treatment, and 16.3 months from the first symptom. A control group of 38 patients, receiving x-ray therapy only, showed a mean survival of 4.4 months from the first treatment and 10.2 months from the first symptom. On the basis of these results, further trials are being pursued, including the use of oxygen inhalations before and during x-ray treatments, together with intravenous Synkavit. The preliminary results appear encouraging but no statistical analysis is yet available.

*Oxygen*: The principle that an increase of oxygen tension during irradiation pro-



duces increased radiation damage is universally accepted. Tumors generally have an anaerobic metabolism with a low oxygen concentration in the tumor cell. If the  $O_2$  concentration of the tumor cells could be experimentally increased, even on a rather limited scale, the damage to the tumor could be appreciably enhanced (by a maximum factor of 4) but that of the surrounding normal tissue only slightly so (6). This thesis is well supported by the experimental studies of Gray, Hultborn, and their colleagues (6-9). Clinical application has been made in several areas, including tumors of the skin, rectum (8), cervix (14), and bronchus (22-24). It is of particular interest in this discussion that the best initial results are reported in epidermoid carcinomas.

*Multicombination Chemotherapy:* Considering ionizing radiation as a multiple antimetabolite, Kligerman and Shapiro (13) have proposed to augment the antienzymatic action of the x-ray beam on the tumor-bearing volume by introducing a variety of chemical antimetabolites during the course of irradiation. Preliminary results recently reported in mammary adenocarcinoma in the mouse appear to be favorable and may lead to clinical trials.

*Porphyrins:* The porphyrin content of tumors is elevated, particularly when they are necrotic and infected (as in bronchogenic carcinoma). Parenterally administered porphyrins localize well in several human and animal tumors, with many tissue effects simulating those produced by ionizing radiation. These include oxidative reactions, denaturation of proteins, and increased permeability of the cell membrane (5, 19, 26). Experimental studies are going forward in several Mid-Western institutions to exploit these effects, in association with x-ray therapy. The objective is to develop potentiation in a variety of animal and human neoplasms, including bronchogenic carcinoma. Of course, an effect could be expected only in the irradiated areas, but a significant increase in the therapeutic index would permit more aggressive irradiation of larger

body areas. Furthermore, metallo-porphyrins can be labeled with radioisotopes, thus selectively localizing radioactive "barbs" in remote metastatic foci.

#### SUMMARY AND CONCLUSIONS

1. We have discussed the status of chemotherapeutic agents at present available for the management of patients with advanced lung cancer, a problem of increasing magnitude and national concern.
2. Although radiation therapy must continue to shoulder the principal burden of responsibility for providing palliation, the polyfunctional alkylating compounds, notably nitrogen mustard ( $HN_2$ ), have proved to be valuable aids in relieving distress and disability when radiotherapy is no longer feasible or effective.
3. We have further discussed other channels of investigation which may yet prove fruitful, such as the use of antimetabolites, radiosensitizers, and multicombination chemotherapy.
4. Bronchogenic carcinoma has been selected as one of the principal targets of an extraordinary cooperative investigation of national scope in cancer chemotherapy, employing carefully planned protocols, critical selection of patients and controls, collection of quantitative data and use of entirely objective criteria for evaluating final results.

VA Hospital  
130 W. Kingsbridge Road  
Bronx 68, N. Y.

#### REFERENCES

1. BATEMAN, J. C.: Chemotherapy of Solid Tumors with Triethylene Thiophosphoramide. *New England J. Med.* 252: 879-887, May 26, 1955.
2. BIERMAN, H. R., SHIMKIN, M. B., BYRON, R. L., JR., AND MILLER, E. R.: Effects of Intra-Arterial Administration of Nitrogen Mustard. *Abst. of Papers, International Cancer Congress, Paris, 1950*, pp. 186-187.
3. BOND, W. H., ROHN, R. J., DYKE, R. W., AND FOUTS, P. J.: Clinical Use of Triethylene Melamine; Report of 75 Cases. *Arch. Int. Med.* 91: 602-617, May 1953.
4. BOYLAND, E., ET AL.: Effects of Chloroethylamines on Tumours with Special Reference to Bronchogenic Carcinoma. *Brit. J. Cancer* 2: 17-29, March 1948.
5. FIGGE, F. H., AND WICHTERMAN, R.: The Effect of Hematoporphyrin on X-Radiation Sensitivity in Paramecium. *Science* 122: 468-469, Sept. 9, 1955.
6. GRAY, L. H.: Biological Actions of Ionizing

- Radiations. In Progress in Biophysics and Biophysical Chemistry, Vol. II, edited by J. A. V. Butler and J. T. Randall. New York, Academic Press, Inc., 1951, p. 240.
7. GRAY, L. H., CONGER, A. D., EBERT, M., HORNSEY, S., AND SCOTT, O. C. A.: The Concentration of Oxygen Dissolved in Tissues at the Time of Irradiation as a Factor in Radiotherapy. *Brit. J. Radiol.* **26**: 638-648, December 1953.
  8. HULTBORN, K. A.: Cancer of the Colon and Rectum: A Clinical and Pathological Study with Special Reference to the Possibilities of Improving the Diagnostic Methods and the Therapeutic Results in Adenocarcinoma. *Acta chir. scandinav.*, suppl. 172, 1953.
  9. HULTBORN, K. A., AND FORSSBERG, A.: Irradiation of Skin Tumours During Pure Oxygen Inhalation. *Acta radiol.* **42**: 475-484, December 1954.
  10. HYMAN, G. A., AND GELLHORN, A.: Myleran Therapy in Malignant Neoplastic Disease: Use of 1,4-Dimethanesulfonyloxybutane with Emphasis on Chronic Granulocytic Leukemia. *J.A.M.A.* **161**: 844-849, June 30, 1956.
  11. KARNOFSKY, D. A., ABELMANN, W. H., CRAVER, L. F., AND BURCHENAL, J. H.: Use of Nitrogen Mustards in the Palliative Treatment of Carcinoma with Particular Reference to Bronchogenic Carcinoma. *Cancer* **1**: 634-656, November 1948.
  12. KARNOFSKY, D. A., ET AL.: Triethylene Melamine in Treatment of Neoplastic Disease; a Compound with Nitrogen-Mustard-Like Activity Suitable for Oral and Intravenous Use. *Arch. Int. Med.* **87**: 477-516, April 1951.
  13. KLIGERMAN, M. M., AND SHAPIRO, D. M.: Augmentation of Radiotherapeutic Effect by Cancer Chemotherapy. *Radiology* **69**: 194-199, August 1957.
  14. KLOPP, C. T., ET AL.: Fractionated Intra-Arterial Cancer Chemotherapy with Methyl Bis Amine Hydrochloride. Preliminary Report. *Ann. Surg.* **132**: 811-832, October 1950.
  15. LANIER, R. R., WHITEHEAD, R. W., DOWNING, M., AND GUM, J.: Physiological and Pharmacological Methods for Increasing Radiation Effects. Exhibit at Forty-second Annual Meeting, Radiological Society of North America, Chicago, Ill., December 1956.
  16. LEVINE, B., AND WEISBERGER, A. S.: The Response of Various Types of Bronchogenic Carcinoma to Nitrogen Mustard. *Ann. Int. Med.* **42**: 1089-1096, May 1955.
  17. LYNCH, J. P., WARE, P. F., AND GAENSLER, E. A.: Nitrogen Mustard in Treatment of Inoperable Bronchogenic Carcinoma. *Surgery* **27**: 368-385, March 1950.
  18. MAGILL, G. B., TAN, C. T. C., REILLY, H. C., PUTNAM, R. C., ADDIO, A. C., AND BURCHENAL, J. H.: Preliminary Clinical Studies with 6-Diazo-5-Oxo-L-Norleucine (DON) in Neoplastic Disease. *Proc. Am. A. Cancer Res.* **2**: 130, April 1956.
  19. MANGANIELLO, L. O. J., AND FIGGE, F. H. J.: Cancer Detection and Therapy; Methods of Preparation and Biological Effects of Metallo-Porphyrins. *Bull. School Med., Univ. Maryland* **36**: 3-7, January 1951.
  20. MAYER, E., AND ROSWIT, B.: Newer Palliative Measures in the Management of Inoperable Bronchogenic Carcinoma. *Dis. of Chest* **21**: 491-512, May 1952.
  21. MILLER, E.: Clinical Trials of Nonane in Malignant Disease. Abst. from Conference on Comparative Clinical and Biological Effects of Alkylating Agents, New York Academy of Sciences and the Cancer Chemotherapy National Service Center, New York City, March 1957. By permission of the author.
  22. MITCHELL, J. S.: Clinical Assessment of Tetra-Sodium 2-Methyl-1:4-Naphthohydroquinone Diphosphate as a Radiosensitizer in the Radiotherapy of Malignant Tumors. *Brit. J. Cancer* **7**: 313-328, September 1953.
  23. MITCHELL, J. S., HOLMES, B. E., MEE, L. K., AND CATER, D. B.: Clinical Trials of Tetra-Sodium 2-Methyl-1:4-Naphthohydroquinone Diphosphate as a Radiosensitizer. *Brit. Empire Cancer Campaign Annual Report*, 1955.
  24. PILLERS, E. M.: Synkavit as Radiosensitizer in Cancer of the Bronchus. Personal communication to the author, November 1956.
  25. RAPHAEL, M., AND REILLY, C. N.: The Use of Nitrogen Mustard in Advanced Bronchogenic Carcinoma. *Dis. of Chest* **25**: 215-220, February 1954.
  26. RASMUSSEN-TAXDAL, D. S., WARD, G. E., AND FIGGE, F. H.: Fluorescence of Human Lymphatic and Cancer Tissues Following High Doses of Intravenous Hematoporphyrin. *Cancer* **8**: 78-81, January-February 1955.
  27. ROSWIT, B., AND PISETSKY, J. E.: Toxic Psychosis Following Nitrogen Mustard Therapy. *J. Nerv. & Ment. Dis.* **115**: 356-359, April 1952.
  28. ROSWIT, B., AND KAPLAN, G.: Nitrogen Mustard as an Adjunct to Radiation in the Management of Bronchogenic Cancer. *Radiology* **57**: 384-394, September 1951.
  29. ROSWIT, B., KAPLAN, G., AND JACOBSON, H. G.: The Superior Vena Cava Obstruction Syndrome in Bronchogenic Carcinoma; Pathologic Physiology and Therapeutic Management. *Radiology* **61**: 722-736, November 1953.
  30. ROSWIT, N., AND KAPLAN, G.: Role of Nitrogen Mustard (HN<sub>2</sub>) as a Systemic Adjunct to the Radiation Therapy of Certain Malignant Diseases. *Am. J. Roentgenol.* **61**: 626-636, May 1949.
  31. ROSWIT, B.: Palliative Treatment. Chapter XII in, *Cancer of the Lung: Pathology, Diagnosis and Treatment*, edited by M. B. Rosenblatt and J. R. Lisa. New York, Oxford University Press, 1956.
  32. SALINE, M., AND BAUM, G. L.: Triethylene Melamine in Bronchogenic Carcinoma with Vena Caval Obstruction. *J.A.M.A.* **156**: 1493-1495, Dec. 18, 1954.
  33. SHAPIRO, D. M.: Quantitative Biochemical Differences as a Basis for Cancer Chemotherapy. *Radiology* **69**: 188-193, August 1957.
  34. SKINNER, E. F., CARR, D., AND DENMAN, W. E.: Treatment of Inoperable Bronchogenic Carcinoma with Methyl-bis ( $\beta$ -Chloroethyl)amine Hydrochloride. *J. Thoracic Surg.* **17**: 428-438, August 1948.
  35. SPITZ, S.: The Histological Effects of Nitrogen Mustards on Human Tumors and Tissues. *Cancer* **1**: 383-398, September 1948.
  36. SULLIVAN, R. D., JONES, R., JR., SCHNABEL, T. G., JR., AND SHOREY, J. M.: Treatment of Human Cancer with Intra-Arterial Nitrogen Mustard Utilizing a Simplified Catheter Technique. *Cancer* **6**: 121-134, January 1953.
  37. SULLIVAN, R. D.: Intra-Arterial Techniques for HN<sub>2</sub> Treatment of Primary Lung Cancer: Experimental Approaches. Personal communication from the author.
  38. SULLIVAN, R. D.: Myleran in Bronchogenic Carcinoma. Abst. from Conference on Comparative Clinical and Biological Effects of Alkylating Agents, New York Academy of Sciences and the Cancer Chemotherapy National Service Center, New York City, March 1957. By permission of the author.
  39. SYKES, M. P., PHILIPS, F. S., AND KARNOFSKY, D. A.: Comparative Therapeutic Activity of the Nitrogen Mustards and Allied Compounds. *M. Clin. North America* **40**: 837-856, May 1956.
  40. THOMAS, S. F.: Combined Therapy: Radiation and Chemicals. *Radiology* **69**: 204-207, August 1957.
  41. WEISBERGER, A. S., LEVINE, B., AND STORAASLI, J. P.: Use of Nitrogen Mustard in Treatment of Serous Effusions of Neoplastic Origin. *J.A.M.A.* **159**: 1704-1707, Dec. 31, 1955.

## SUMMARIO IN INTERLINGUA

## Stato Presente del Chimioterapia de Cancere Bronchial

Es discutate le stato del cosas in re le agentes chimotherapeutic que es nunc disponibile pro le tractamento de cancro in stadios avantiante. Ben que le therapia radiational continua portar le major responsabilitate in provider palliation, le compositos alkylante a function polyforme—specialmente mustarda a nitrogeno ( $\text{HN}_2$ )—se ha monstrate auxilios de valor

in alleviar le suffrentia e le invaliditate del patiente con primari cancro pulmonar quando le radiotherapia ha cessate esser practicabile o efficace.

Es etiam discutate altere campos investigatori—illos del antimetabolitos, del radiosensibilisatores, e del chimioterapia multicombinatori—in que il existe le possibilitate de successos futur.

## DISCUSSION

(*Papers by Karnofsky, Golbey and Pool; Buschke; Schulz; Roswit*)

**Willard Van Hazel, M.D.** (Chicago, Ill.): I wish to thank Dr. Garland for inviting me here today to listen to the speakers who were so well chosen to present this symposium. I was fascinated by the meticulous study of bronchogenic carcinoma related by Dr. Karnofsky. The rate of cancer growth has interested me for several years. We know that in some carcinomas hormones may accelerate or deter growth, which is true also of certain chemicals as demonstrated in animal study. But what factors are at work to protect one host and not another? There is no one with experience who has not explored a chest with a small silent lesion to find the tragic picture of widely disseminated disease over the pleura, pericardium, and diaphragm. Our surveys will not help such a patient, but I am not pessimistic about surveys if each abnormal shadow is thoroughly investigated.

There is inherent in each host or each tumor the possibility of a cure. Our treatment may have less to do with it than factors of which we are still unaware. I feel strongly, therefore, that the search for patterns or more complete data, as suggested by Dr. Karnofsky, can only lead to a better treatment for all, whatever form that treatment may take. Surgery up to now has afforded a slightly better overall average of survival in bronchial carcinoma than other methods, but only in a few isolated groups have resectable lesions been treated by radiation. Bignall reported this year, in *Lancet*,<sup>1</sup> that in a group receiving x-ray therapy there was a survival rate of 35 per cent for one year and 15 per cent for two years, whereas in an untreated group there were only 24 per cent living after one year and 6 per cent after two years. Though there was no evidence of metastases in this series, 11 per cent of those treated were considered unsuitable for surgery; in 27 per cent of the untreated group the tumors were not considered resectable.

<sup>1</sup> Bignall, J. R.: Bronchial Carcinoma. Effect of Radiotherapy on Survival. *Lancet* 1: 876, 1956.

In 1949, we explored a patient with a squamous-cell carcinoma of the bronchus. A roentgenogram in 1942 had shown a complete atelectasis on the left side. On his way to undergo bronchoscopy by Dr. Holinger, the patient coughed up a piece of tissue, which showed squamous-cell carcinoma. His lung was fully aerated at this time and Dr. Holinger was unable to find evidence of any tumor in the bronchus despite the former complete obstruction. The patient was referred to a surgeon, who decided not to operate because of the negative findings. Five years later there was a small shadow in the left upper lobe, but this was not regarded as tumor by the examining physician. Only after seven years did the recurrence take on the aspect of dire need for surgery, but deterioration had occurred almost entirely in the last three months of life.

We also saw a young man who had lost a leg because of an osteogenic sarcoma eleven years earlier. After this interval he was examined because of an osteoarthopathy in the remaining ankle. At the same time Dr. Willy took a roentgenogram of the chest, showing a lesion in the upper left lobe. This lobe was removed and showed a histologic picture identical with that in the leg. It can be assumed that for eleven years these cells lay silent only to manifest themselves in the peculiar phenomenon of pulmonary osteoarthopathy.

Dr. Buschke has with great clarity stated the problem of the patient with the inoperable lesion, determined by preoperative study or an exploratory thoracotomy. The distressing fact that we already have an extensive disease which has gone beyond the limits of the lung itself challenges our patience. But no group needs our consideration more.

I am in accord with those who feel that an oat-cell tumor can rarely be benefited by surgery if that diagnosis can be made preoperatively. On occasion, the man at thirty or forty, with a family of children, has led us to extend our indications with this type of lesion but always with disappointing results, even as a palliative measure. As in any

anaplastic tumor, the immature cells will respond to the physical agents under discussion and these can be used with gratifying results even though benefit may be transient.

We all have been impressed by the response of some tumors to therapy regardless of the cell type. This may be explained in part by the transitional epithelium found in the respiratory tract. The more one studies these cells the more he becomes aware of the great variations which occur sometimes in the same tumor. Herein lies one factor which may determine our varied response to therapy. During the past year we have seen a patient with recurrence of carcinoma after eleven years of freedom from all symptoms. Hoarseness was the first sign of recurrent disease. Another patient had a squamous-cell carcinoma of the left lung eight years before the development of an oat-cell tumor in the right lung.

Dr. Schulz has further confirmed the efficacy of radiotherapy in an otherwise hopeless and wretched group. It would not be from choice that one would select these cases. The group of patients he cited, even with anaplastic tumors, indicates the potentialities of such treatment and also the unknowns in prediction of the response. Our surgical survivals for all cases with resection are about comparable to his and leave much to be desired:

	Operations	Survivals
1955	51	22 43%
1954	37	15 40%
1953	29	6 20%
1952	26	5 19%
1951	33	6 18%
1950	21	5 23%
	197	59

Nitrogen-mustard therapy in carcinoma of the lung has been used by us for nine years, sometimes alone, sometimes combined with radiotherapy, and also as a follow-up in resected cases where obvious tumor remained in the mediastinum. To this group there have been added more recently some cases which have not shown any extension beyond the resected area at the time of operation and were considered therefore as favorable cases. Dr. Roswit, with his wide experience, has well outlined the indications and contraindications in the use of this form of treatment and adequately shown the usefulness of its application. The past few years have seen increasing reports of its palliative effects by many observers.

Dr. Warren Cole, at the University of Illinois, has shown tumor cells in the smears made from the large bowel at the point chosen for anastomosis in resected carcinoma lesions. It is conceivable that the manipulation of a tumor at operation may cause cancer cells to be circulated in the blood. These undoubtedly may die unless they lodge and take root and establish a blood supply, later showing up as a metastatic lesion. It, therefore, appears reasonable to believe that a drug disseminated through the blood stream may reach such cells and inhibit their growth. This seems to me to make chemotherapy a rational adjunct in a case receiving radiotherapy directed over the more obvious tumor whether that be primary or metastatic.

To this organization we are deeply indebted for the progress in the diagnosis of chest diseases. Where could we turn without your help? I trust that new doors may be opened because of our mutual continued interest in the distressing and ever-increasing problem of bronchogenic carcinoma.





## The Vertebral and Azygos Venous Systems, and Some Variations in Systemic Venous Return<sup>1</sup>

HERBERT L. ABRAMS, M.D.

THE VENOUS system of man, in accord with conventional anatomic description, is divided into two main groups: the pulmonary veins and the systemic veins. With the exception of the cardiac veins, the systemic venous drainage returns to the heart through two great vessels, the superior and the inferior vena cava. From the cranial cavity and the upper extremities the blood converges on the superior vena cava, and from the abdominal viscera and lower extremities on the inferior vena cava. Obstruction of either of these trunks is not incompatible with life in man (5, 36, 39).

The development of a large by-pass mechanism, effectively establishing communication between the two vast caval drainage areas, is accomplished by collateral vessels, of which the vertebral veins and the azygos system form an important component (34, 37, 39, 40). In the dog, both venae cavae may be occluded for thirty minutes, with survival, if the azygos vein is patent (3). This is accompanied by a fivefold increase in azygos blood flow. How this is possible becomes apparent after consideration of the intercommunications of the vertebral veins (4, 37). At the base of the brain, they anastomose extensively with the venous trunks of the cranium; in the neck, with the deep cervical veins; in the thorax and abdomen, with the intercostal and lumbar veins; in the pelvis, with the large venous plexuses anterior to the sacrum. In turn, the sacral and lumbar veins communicate directly with the inferior vena caval system, the lumbar and intercostal veins with the azygos system, and the azygos system with the superior vena cava and its branches (26).

In the early 1940's, Batson revived interest in the vertebral system of veins by demonstrating that a thin opaque medium injected into the dorsal vein of the penis of a cadaver would spread into the sacral canal, fill the veins in the wings of the bony pelvis, and finally move up the vertebral system as far as the cranial cavity. The mode of spread was similar to that of carcinoma of the prostate, and Batson suggested that in the great venous lakes formed by these plexuses, tumor emboli might well spread from origin to final site of deposition. He also showed that the vertebral veins filled, following injection in a live monkey, if the inferior vena cava were compressed (6-8).

Shortly after Batson described the anatomy of the vertebral veins and expounded his theory of their role in metastases, Harris went to great lengths to prove that Batson's ideas were neither new nor original (24). As a matter of fact, the vertebral venous system was by no means unknown to anatomists prior to Batson's time, although Franklin in his *Mono-graph on Veins*, written in 1937, did not even mention the vertebral plexuses (20). Willis in 1664 (48) and Winslow in 1732 (49) characterized the structure of the spinal veins. Bock in 1823 described the rich plexuses within the bony canal, the posterior venous plexus, and the azygos system (9). Even the suggestion that the vertebral venous system is a storage reservoir, as well as a drainage channel, goes back a century. Quain pointed out in 1828 that the blood from "the interior of the spine is conveyed into the great spinal veins, which are wider in the middle than all their extremities and therefore resemble so many reservoirs..." (38).

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Hilton, in 1855, stated: "The absence of valves in the whole of these venous tubes is a circumstance which is doubtless connected with a wise intention. It enables the blood to pass in either direction, and consequently, greatly increases the freedom of venous circulation; a point of essential importance with an organ whose functional capacity is so liable to interruption under so slight a disturbance of the balance of its circulating fluid" (27).

Batson's real accomplishments, then, were to recognize that this reservoir might be a channel through which tumor emboli could travel to near or distant foci, and to redirect attention to a relatively neglected area of the venous system.

Some years after Batson's original reports, Johnstone attempted to repeat his work (30). He concluded that there is no evidence that the vertebral veins provide the main route for the spread of metastases in carcinoma of the prostate or the breast, and he was unable to establish effectively that opaque medium injected into the dorsal vein of the penis actually reaches the cranial cavity.

In 1951, Lawrence and Moore demonstrated experimentally that, when the inferior vena cava and the epigastric and lumbar veins are ligated, the vertebral veins are an effective route for spread of tumor to the vertebrae and lungs in rabbits (32). They injected a suspension of transplantable rabbit carcinoma cells into the femoral vein, with resultant metastatic spread *via* the vertebral venous system. Even if the azygos vein were also ligated, pulmonary metastases developed. Coman and DeLong injected viable tumor cells into the femoral veins of 14 animals while abdominal compression was employed; in 12, tumors appeared in the vertebral venous system (14). Microscopic sections revealed that the growth usually arose from emboli in the large thin-walled vertebral veins. There were no emboli in the arterioles, indicating that the tumor had not passed through the lungs and returned *via* the arterial tree. Of 16 control animals which received

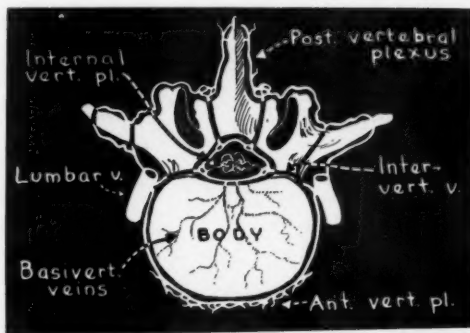


Fig. 1. Diagrammatic representation of the vertebral plexuses at the lumbar level (seen from above). The external plexuses include anterior components—in front of the vertebral bodies—and posterior components which surround the spinous and transverse processes. The internal plexuses include the dural and spinal veins, the longitudinal sinuses, and the basivertebral veins which drain the vertebral bodies. The internal and external plexuses communicate with the intervertebral veins, which terminate in the lumbar veins. The lumbar veins are connected with both the inferior vena cava and the ascending lumbar veins.

injections of tumor cells without abdominal pressure, 15 had tumor implants in the lungs alone, with no evidence of tumor in the spinal column. These authors agreed that the vertebral vein offers a transport avenue for tumor emboli from prostatic and breast carcinoma and that perhaps coughing or the Valsalva experiment—which increase intra-abdominal pressure—might suffice to shift blood from the inferior vena cava to the vertebral or azygos system. Others have emphasized the importance of this system as a means of spreading infection (13).

There is thus some evidence that the paravertebral and azygos venous networks may play an important role in the presence of disease. In some animals the azygos veins constitute the main venous channels of the thorax (22). Foreign substances in the spinal theca drain directly through the vertebral veins into the azygos system (28). The usefulness of the Queckenstedt maneuver depends on the free flow of blood into the vertebral veins following occlusion of the internal jugular vein, with consequent distention of the vertebral veins and a rise in cerebrospinal fluid pressure in the absence of

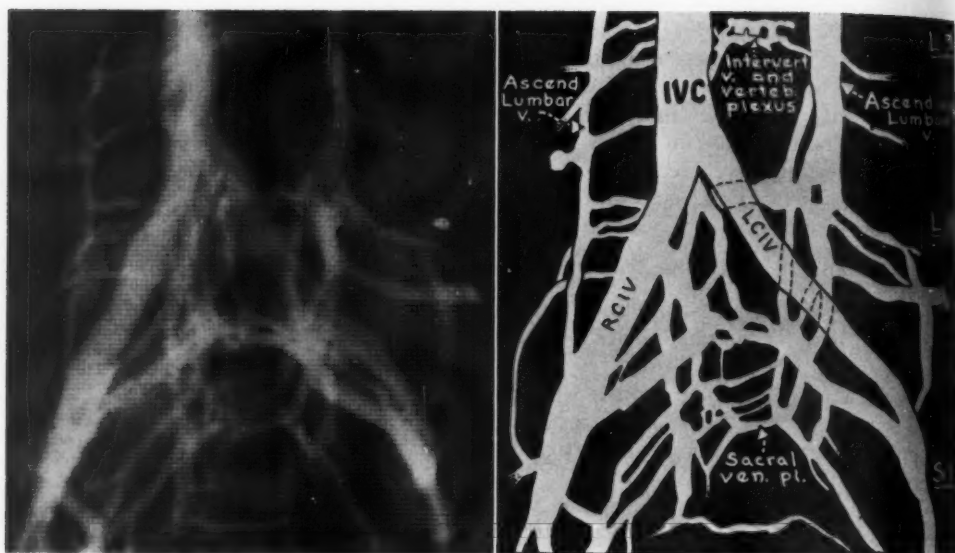


Fig. 2. Sacral venous plexuses in a 7-month-old girl, anteroposterior projection. The ramifying channels of the sacral venous plexuses and their connections both with the common iliac veins and the ascending lumbar veins are visible. The common iliac veins unite to form the inferior vena cava at the level of L-4. Double ascending lumbar veins are present, well opacified on the right (the medial ascending lumbar vein on the right is somewhat obscured by the inferior vena cava). Two of the segmental lumbar vertebral plexuses are visualized. (RCIV. Right common iliac vein. LCIV. Left common iliac vein. IVC. Inferior vena cava.)

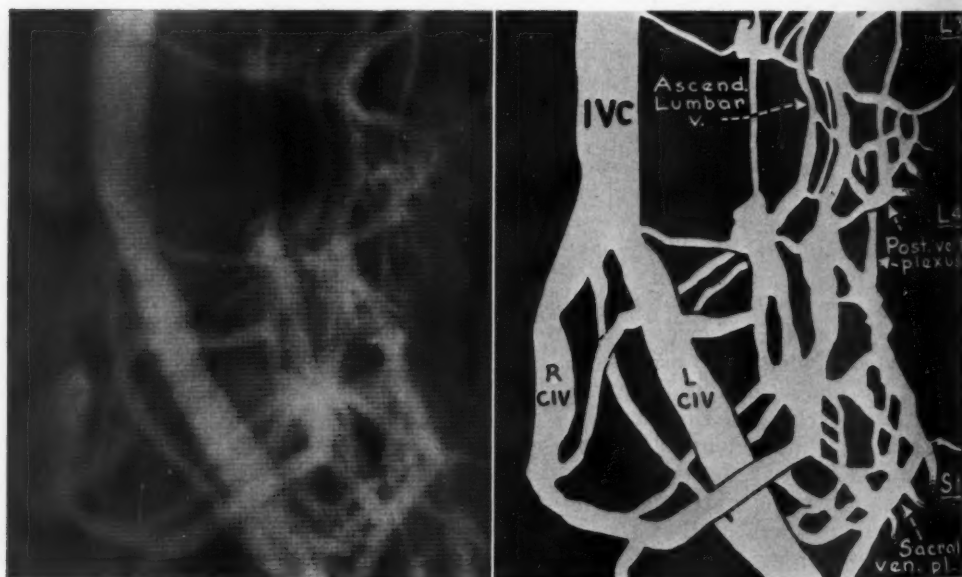


Fig. 3. Sacral venous plexuses. A steep right posterior oblique projection brings out the rich anastomoses between the common iliac veins, the sacral, ascending lumbar, and vertebral veins. The ascending lumbar veins communicate with the inferior vena cava by transverse channels. Note how the posterior vertebral plexuses surround the spinous and transverse processes of the vertebrae. (LCIV. Left common iliac vein. RCIV. Right common iliac vein. IVC. Inferior vena cava. Post. vert. plexus. Posterior vertebral plexus.)

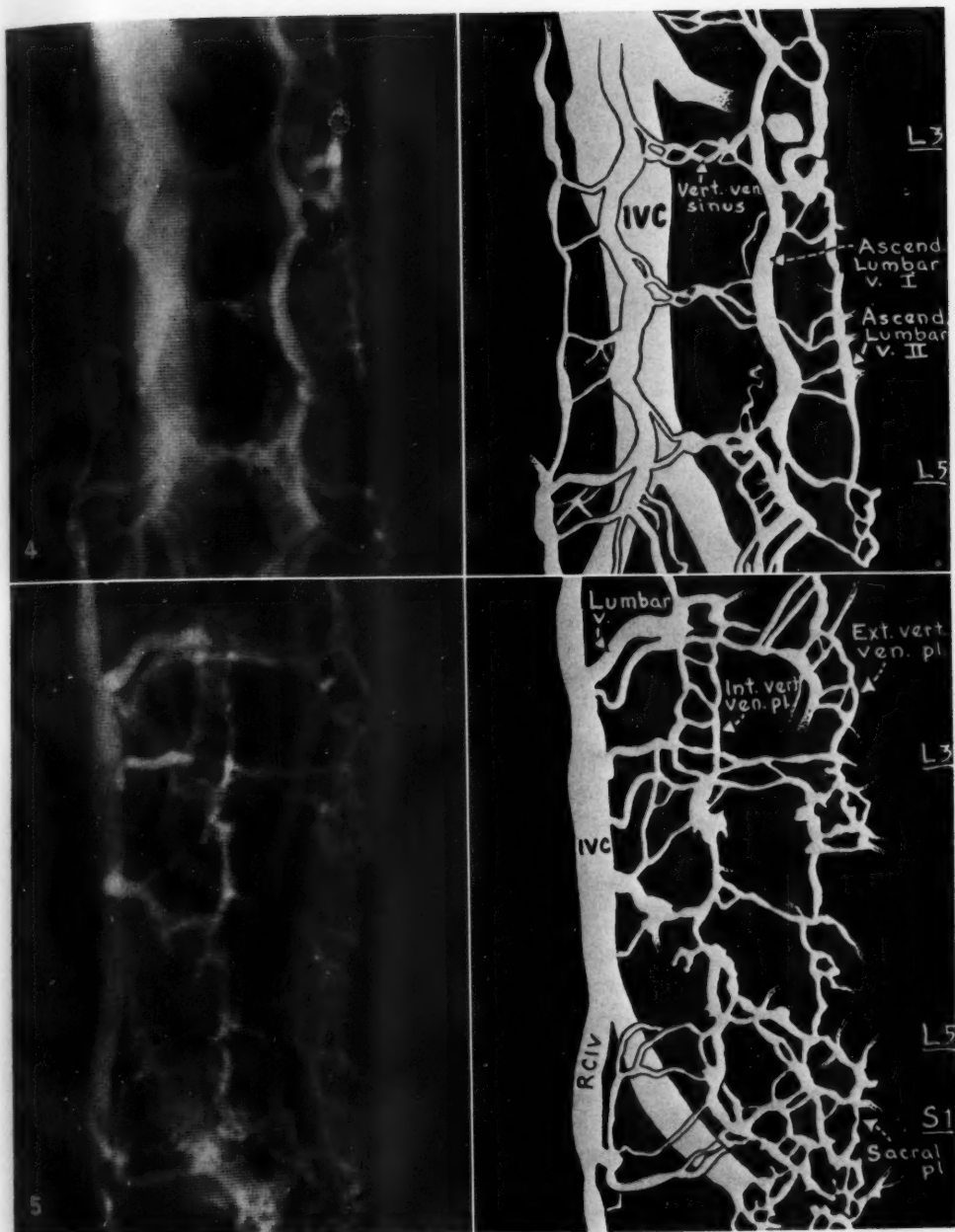


Fig. 4. Lumbar vertebral veins in a 5-month-old boy, anteroposterior projection. There is simultaneous filling of the inferior vena cava and paravertebral veins. The segmental character of the vertebral plexuses is shown, as well as their relationship to the mid-portion of the vertebral bodies. This derives from the participation of two somites in the formation of each vertebral body. Ascending lumbar veins are present bilaterally.

Fig. 5. Lumbar vertebral veins, steep right posterior oblique projection. The communications of the lumbar veins on both sides with the inferior vena cava anteriorly, the ascending lumbar veins and the vertebral plexuses posteriorly, are clearly shown.



Fig. 6. Sacral and lower lumbar vertebral veins in a 2-month-old boy. The plexiform character of the vertebral veins and the profuseness of their ramifications are illustrated in this study. The ascending lumbar channels are occasionally large and almost equal in size to the inferior vena cava, as in this case.

block (26). The prominence of the azygos vein may be exaggerated in the presence of congestive heart failure (18), and it has been mistaken for enlarged lymph nodes or even a tumor (10).

The radiologic anatomy of these veins has commanded increasing attention in recent years. Anderson, in 1950, duplicated Batson's work in detail (2) and extended the study to living adults. He succeeded in opacifying the vertebral veins following femoral vein injection of Diodrast if abdominal compression were employed. Robinson injected Neoprene into 8 still-born infants, but was unable to obtain satisfactory roentgenographic studies (39). Mellins reported 70 inferior vena cavagrams, in 12 of which the azygos system opacified (34). In 6 of these 12 cases, the vertebral venous plexus was demonstrated. In 9 of the 12 there was inferior vena caval obstruction, and in 1 there was increased intra-abdominal pressure at the time of examination. The

method described by Anderson of opacifying the vertebral and azygos veins by femoral vein injection with simultaneous inferior vena caval compression has been employed by Helander and Lindbom in a study of 70 cases (25). They have suggested that the method might be applicable to the localization of expanding processes in the vertebral canal. Nordenström has modified this method in the experimental animal, using a catheter balloon to obstruct the inferior vena cava, and has obtained some excellent studies in dogs (35).

Intra-osseous phlebography represents an alternative method of demonstrating the vertebral veins and the azygos system. Since Fischgold and his coworkers first described this method in 1952 (17), a number of other workers have demonstrated its efficacy in showing both the normal pattern and the effect of metastatic tumor in creating venous obstruction (33, 44, 46, 47).

Finally, it should be possible to opacify

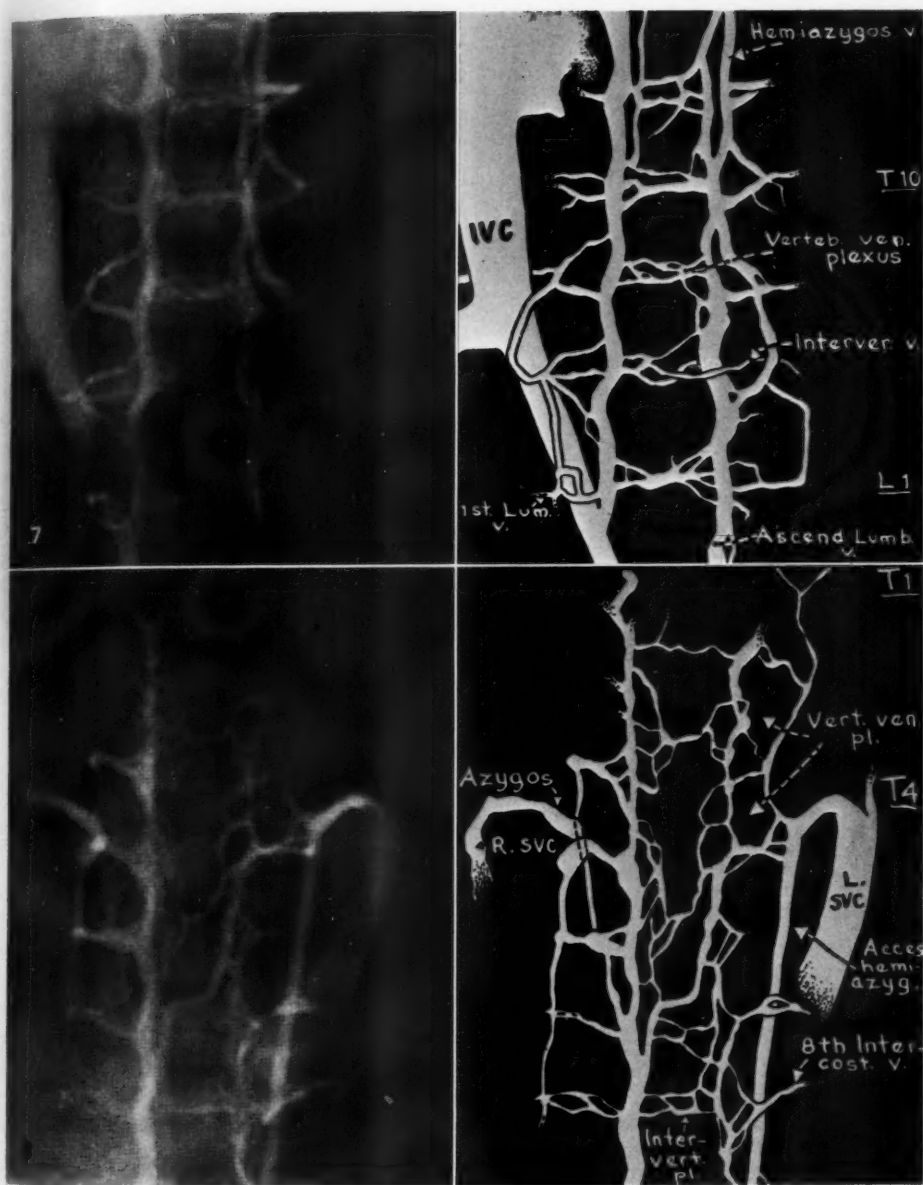


Fig. 7. Lower thoracic vertebral venous plexuses. At this level, the vertebral veins are similar to those in the lumbar area and now drain into the intercostal veins, which in turn empty into the hemiazygos and azygos channels.

Fig. 8. The vertebral veins at the upper thoracic level. The vertebral venous plexuses are opacified following the injection of the opaque medium into the left saphenous vein. The primitive paired arrangement of both the azygos and the superior vena cava is preserved, the accessory hemiazygos emptying into the left superior vena cava, and the azygos into the right superior vena cava. The medial portions of the intercostal veins are opacified. (R. SVC. Right superior vena cava. L. SVC. Left superior vena cava. Access. hemiazyg. Accessory hemiazygos vein.)



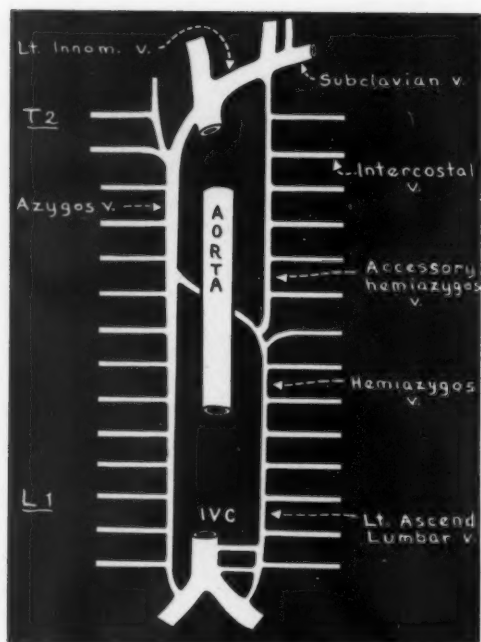


Fig. 9. Diagrammatic representation of the azygos venous system. The segmental lumbar veins are joined to each other by a longitudinal vessel, the ascending lumbar vein. The right ascending lumbar vein, as it enters the thorax, becomes the azygos vein, and the left ascending lumbar vein is continuous with the hemiazygos vein. The hemiazygos vein crosses in front of the vertebral column at the level of T-8 or T-9 to join the azygos vein. The accessory hemiazygos vein is continuous with the hemiazygos, receives the upper thoracic veins on the left, and joins the left superior intercostal vein above.

the azygos system by retrograde injection through a catheter inserted from the superior vena cava (43).

In most descriptions of the efforts to opacify the vertebral system *in vivo*—with the exception of intra-osseous injection into the area drained by this system—obstruction of the inferior vena cava by abdominal pressure, by ligation, or by catheter balloon has figured prominently. It can be clearly shown, however, that the interlinkage between the caval and vertebral systems is so intimate and extensive that caval obstruction is not necessary for opacification of (and hence for blood flow from the lower extremities through) the vertebral venous plexuses in man.

#### THE NORMAL VERTEBRAL AND AZYGOS VENOUS SYSTEMS

Four years ago, we began to perform a number of angiocardigraphic injections through the saphenous or femoral veins. We were struck by the degree of filling of the paravertebral vessels. Analysis of forty sequential studies showed significant opacification of the vertebral and azygos systems in about two-thirds of the cases. The ages of these patients—from twenty-six days to four years—did not differ significantly from those in the group in which only the caval veins were visualized. The site of injection, whether saphenous or femoral vein, right or left side, had no effect on the degree of opacification of the vertebral plexus. The underlying cardiac anomalies seemed to be of little import, although right ventricular hypertension was present in virtually all cases with vertebral vein opacification. On the other hand, in the group with caval opacification alone there were also a number of instances of pulmonic stenosis or increased peripheral pulmonary arteriolar resistance. The relative volume and the type of medium were the same for both groups, as was the speed of injection. In brief, it is impossible to state why vertebral vein opacification was noted in two-thirds of the cases, but not in the other third.

These studies not only yielded some remarkably clear radiologic demonstrations of the normal channels, but also illustrated some of the variations in venous anatomy and the alternative avenues of venous return to the heart. It seemed desirable to describe the intercommunications of these systems as they are seen in life.

**The Vertebral Veins:** The vertebral venous system is composed of transverse, interconnecting plexuses of veins which anastomose with similar networks above and below by thin-walled longitudinal channels. At a single level, for example, the external plexuses include anterior components—in front of the vertebral bodies—and posterior components which surround the appendages. The internal

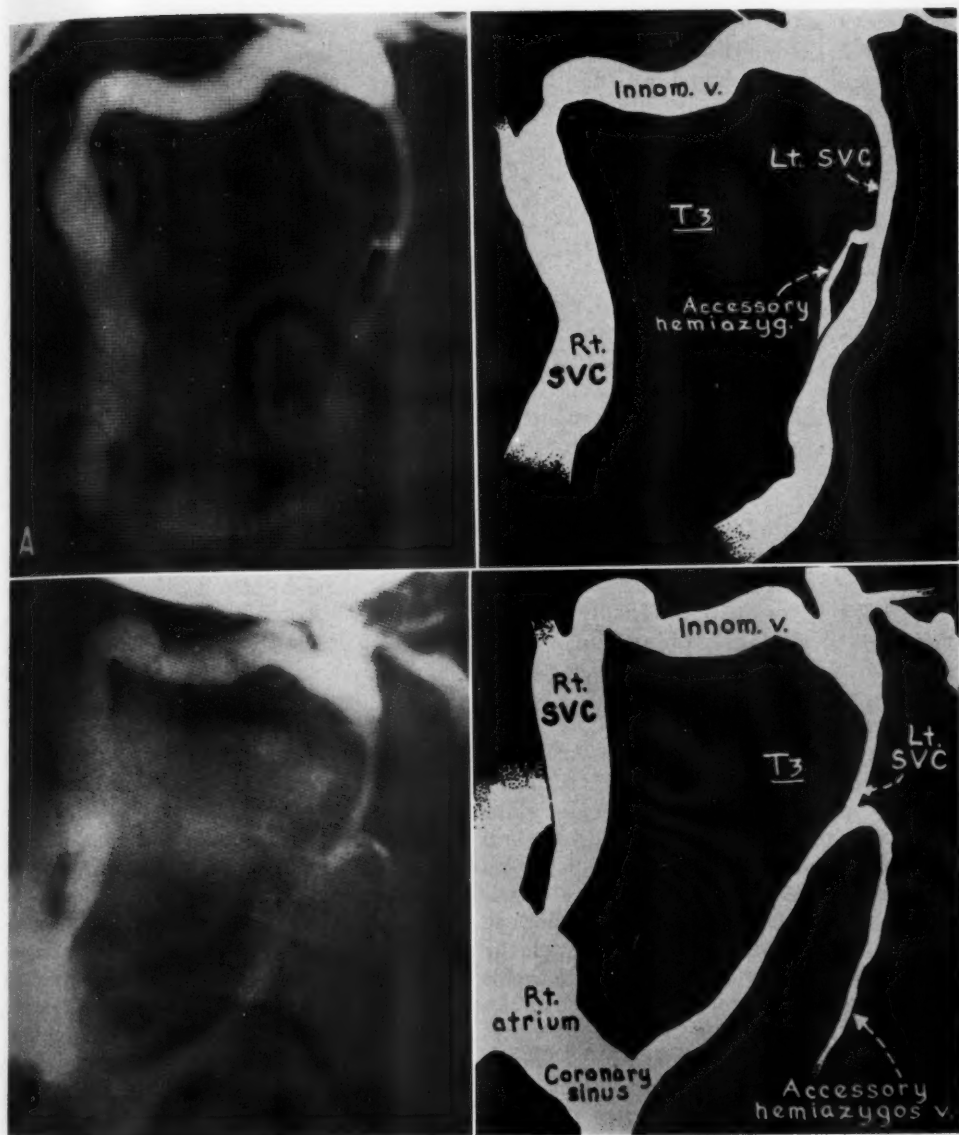


Fig. 10. Variations in systemic venous return: accessory hemiazygos vein entering a left superior vena cava. A. Anteroposterior projection. The left superior vena cava is small by comparison with the right, and the innominate vein large.

B. Right posterior oblique projection. The posterior position of the accessory hemiazygos vein is shown, as well as the entrance of the left superior vena cava into the right atrium through the coronary sinus. (Lt. SVC. Left superior vena cava. Rt. SVC. Right superior vena cava.)

plexuses include the longitudinal sinuses, the dural and spinal veins, and the veins which drain the vertebral bodies (basivertebral veins) (Fig. 1). Both the internal and the external plexuses drain into the

intervertebral veins, which communicate directly with the sacral, lumbar, intercostal, and cervical vertebral veins.

In the sacral region (Figs. 2 and 3), the extent to which the sacral plexuses are in

continuity with the major channels from the lower extremities is readily demonstrated. The common iliac and internal iliac veins communicate by a host of channels with vertebral and ascending lumbar veins. Similarly, the inferior vena cava throughout the lumbar region communicates with the lumbar veins at every level, and hence with the ascending lumbar trunks (Figs. 4 and 5).

The plexiform nature of the lumbar vertebral veins and their segmental arrangement are nicely illustrated in Figure 6. This arrangement is sustained in the thoracic region, where the vertebral drainage is into the intercostal veins (Figs. 7 and 8).

*The Azygos System:* The segmental lumbar veins are joined to each other by a longitudinal vessel, the ascending lumbar vein. On either side of the spine, there may be one or two ascending lumbar veins. The right ascending lumbar vein, as it enters the thorax, becomes the azygos vein, and the left ascending lumbar is continuous with the hemiazygos chain (Fig. 9). In two-thirds of the cases, the left renal vein is connected to the ascending lumbar or hemiazygos vein (4). This latter vein crosses in front of the vertebral column at the level of T-8 or T-9 to join the azygos vein. The accessory hemiazygos vein receives the upper thoracic veins on the left and is continuous with the hemiazygos below and the left superior intercostal above.

#### SOME VARIATIONS IN SYSTEMIC VENOUS RETURN

No single description of the vertebral and azygos systems can be entirely correct, since the patterns of systemic venous return show an enormous number of variations (1, 4, 11, 15, 19, 21, 23, 31, 42, 50). Seib described twenty-one different patterns of the azygos venous system found in dissections of human adult cadavers (41). Persistence of a left superior vena cava is probably the commonest and best known variation in venous anatomy (47), but absence of the

inferior vena cava (15, 42), drainage of the inferior vena cava (21) or superior vena cava (1) into the left rather than into the right atrium, and pre-esophageal location of the azygos and hemiazygos veins (19), with resultant stricture, have all been described.

Figure 10 demonstrates in anteroposterior and right posterior oblique projections the retrograde filling of the accessory hemiazygos vein in the presence of bilateral superior venae cavae. Figure 11 shows an example of a persistent left inferior vena cava, a vessel which may be present in a small percentage of cases but is usually tiny (4) rather than a major channel. Figure 12 demonstrates the pathway that blood from the upper extremity may follow in the presence of superior vena caval or innominate vein obstruction. In this case, the innominate vein was hypoplastic. Because there was no easy communication between the left subclavian vein and the superior vena cava, the blood passed through a large superior intercostal vein into the accessory hemiazygos and thence into the azygos vein and superior vena cava. In addition, anastomotic channels filled the inferior vena cava in retrograde fashion, and thus established another route of venous return to the heart into the caudal portion of the right atrium. Hypoplasia of the innominate vein may also be associated with persistence of a left superior vena cava entering the coronary sinus (Fig. 13).

If the inferior vena cava is occluded, blood from the lower extremities may reach the heart through the paravertebral and azygos systems. If the inferior vena cava is congenitally absent, the same avenues will be utilized. Figure 14 demonstrates a huge hemiazygos vein as the major channel from the abdomen, emptying into the superior vena cava and thence into the right atrium. In Figure 15, the large hemiazygos empties into a left superior vena cava which communicates with the right atrium through the coronary sinus. At least 24 cases of so-called "absence of the inferior vena cava" have



Fig. 11. Variations in systemic venous return: left inferior vena cava. In a small percentage of cases, the left inferior vena cava persists as a tiny vessel. In this case it forms the main channel of venous return from the abdomen, and the right inferior vena cava (remnant of right supracardinal vein) is diminutive. (LIVC. Left inferior vena cava.)

been reported in the literature (15, 16, 31, 42). The term is somewhat of a misnomer, since it is usually only the hepatic portion of the inferior vena cava which is absent. In the reported cases, the venous drainage of the inferior vena cava reached the heart through the azygos and superior vena caval systems.

Rarely, one or both of the venae cavae may enter the left atrium (1, 12, 21, 45). In these cases, the return of systemic venous blood to the left heart produces definite peripheral arterial oxygen unsaturation. In the case shown in Figure 16, the left superior vena cava entered the left atrium and the right superior vena cava drained into the right atrium. Figure 17 illustrates an instance of hemiazygos venous drainage into the left atrium associated with absence of the inferior vena cava.

#### DISCUSSION

Batson's concept of the vertebral venous system as a large, low-pressure, intercommunicating reservoir of blood, in which alterations in pressure and direction of flow may occur, receives some support from the present studies. In each of these studies, the patient was supine, and no pressure was applied to the inferior vena cava or the abdomen. Yet injection into the saphenous or femoral vein was frequently followed by opacification of the vertebral and azygos venous systems. In some instances, the opaque medium traveled well above the termination of the azygos vein, as high as the level of the first thoracic vertebra (Fig. 9). Since the venous drainage from the upper thorax normally runs caudad toward the right atrium, a reversal of direction of flow must be presupposed. A clear demonstra-



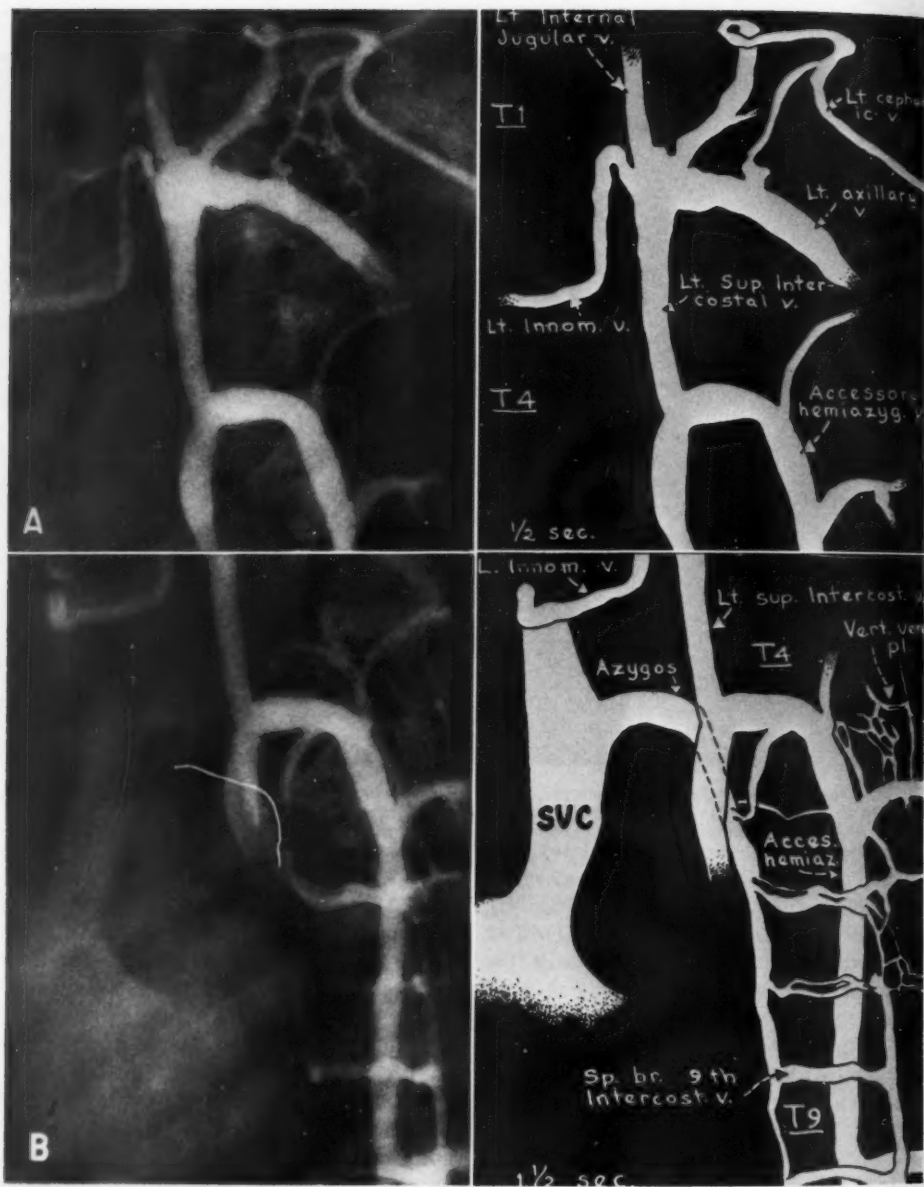


Fig. 12. Variations in systemic venous return: hypoplasia of the left innominate vein, with visualization of the azygos and paravertebral veins from above. The opaque medium was injected into the left cephalic vein with the patient in the steep right posterior oblique projection. Because the left innominate vein is hypoplastic, no easy communication between the left subclavian vein and the superior vena cava is possible, and the opaque medium enters a large superior intercostal vein to join the hemiazygos system. From the hemiazygos vein, the spinal branches of the intercostals are opacified, and cross-communications with the azygos become visible, associated with filling of the vertebral plexus. Thereafter, the opaque medium flows caudad, reaches the inferior vena cava through collateral vessels, and then returns cephalad through the inferior vena cava into the right atrium.

A. One-half second after injection. The left cephalic, left axillary, and left superior intercostal vein are opacified, as is the accessory hemiazygos. A small left innominate vein is visible.

B. One and one-half seconds after injection. The opaque medium has filled the accessory hemiazygos, some of the intercostal veins, and the azygos vein, and opacification of the superior vena cava of moderate degree is now noted. (Sp. br. Spinal branch.)



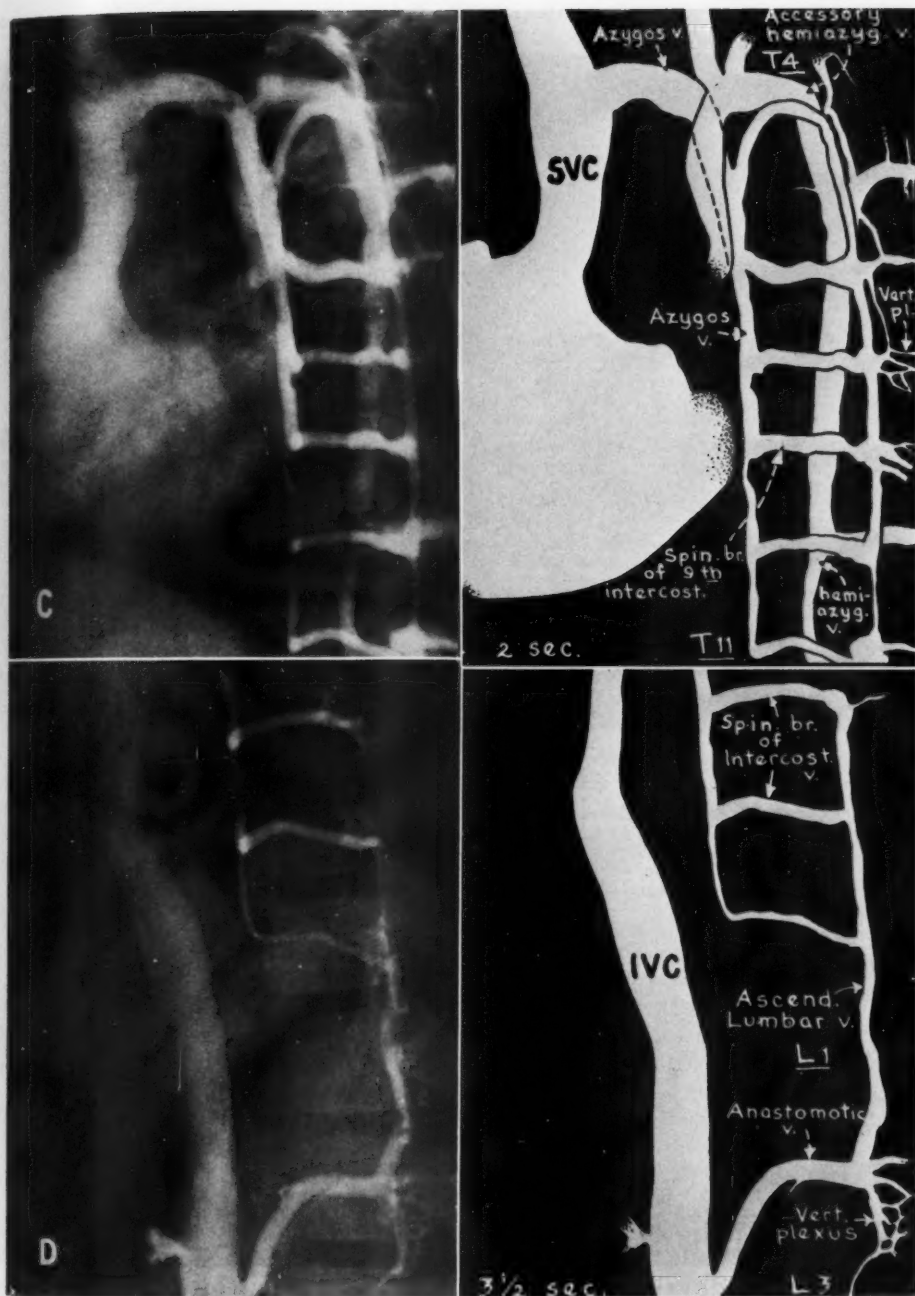


Fig. 12. Variations in systemic venous turn: hypoplasia of left innominate vein, with visualization of the azygos and paravertebral veins from above.—*cont.*

C. Two seconds after injection. The azygos vein is now more densely opacified, as are some of the spinal branches of the lower intercostals, and the hemiazygos vein.

D. Three and one-half seconds after injection. The inferior vena cava has become opacified following caudad flow of the opaque medium through the hemiazygos vein and thence into collateral channels. The opaque medium is now flowing cephalad through the inferior vena cava into the right atrium.

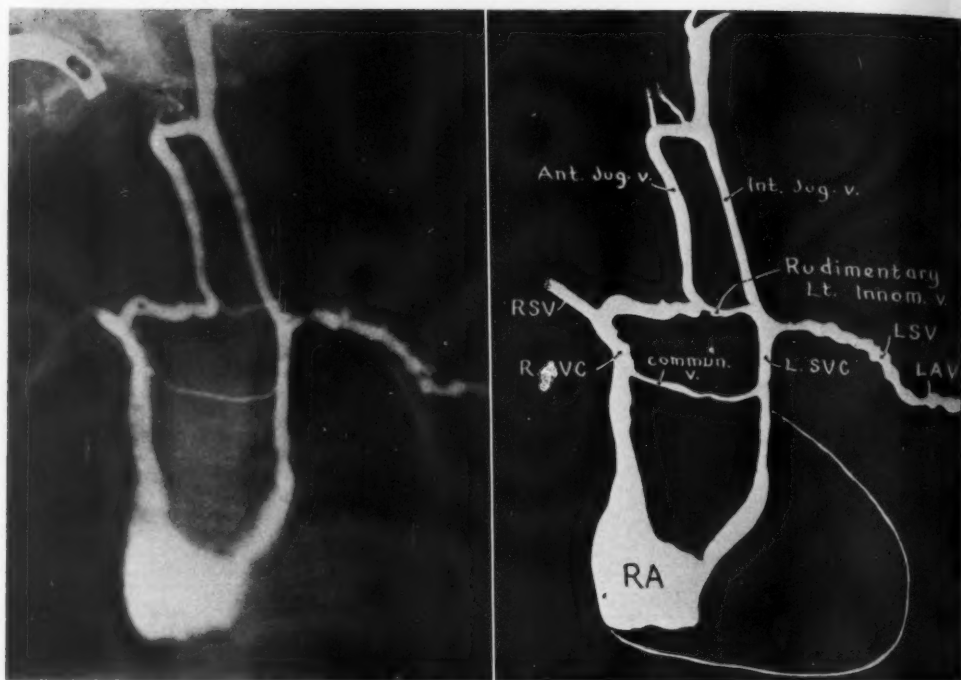


Fig. 13. Variations in systemic venous return: hypoplasia of the left innominate vein associated with persistent left superior vena cava. Following injection of the left antecubital vein, the left axillary and subclavian veins are opacified. A persistent left superior vena cava draining into the right atrium *via* the coronary sinus is noted, and the innominate vein is observed to be hypoplastic. The opaque medium ascends into the internal jugular vein, communicates with the anterior jugular vein, which in turn allows opacification of the right superior vena cava. A communicating vein between right and left superior venae cavae is present. (LAV. Left axillary vein. LSV. Left subclavian vein. L. SVC. Left superior vena cava. R. SVC. Right superior vena cava. Commun. v. Communicating vein. RSV. Right subclavian vein. RA. Right atrium.)

tion that opacified blood from the left upper extremity could travel through the azygos and paravertebral route into the abdomen, reach the inferior vena cava, and then ascend into the right atrium, has also been given (Fig. 12).

The injection of the opaque medium into the respective veins of the lower and upper extremity was, of course, performed under pressure. But it seems unlikely that the pressure employed in manual injection exceeded the pressure at times attained in the thorax by coughing and the Valsalva maneuver, or in the abdomen by bearing down. Under the conditions of these injections, the profuseness of the connections between caval and vertebral venous systems on the one hand and

vertebral and azygos systems on the other was clearly delineated.

The plexiform structure of the vertebral veins is in marked contrast to the venous drainage of such viscera as the liver, the spleen, the heart, and the lungs. The arrangement is distinctly primitive, and, in a sense, a persistence of the plexoid venous system of the embryo. Whereas the sinusoidal venous network of such an organ as the liver is transformed early in embryonic life into a congruous, relatively uniform pattern, in which small vein confluence forms ever larger channels of venous return, no such change occurs in the vertebral venous drainage.

In attempting to illustrate some of the normal components of the vertebral and

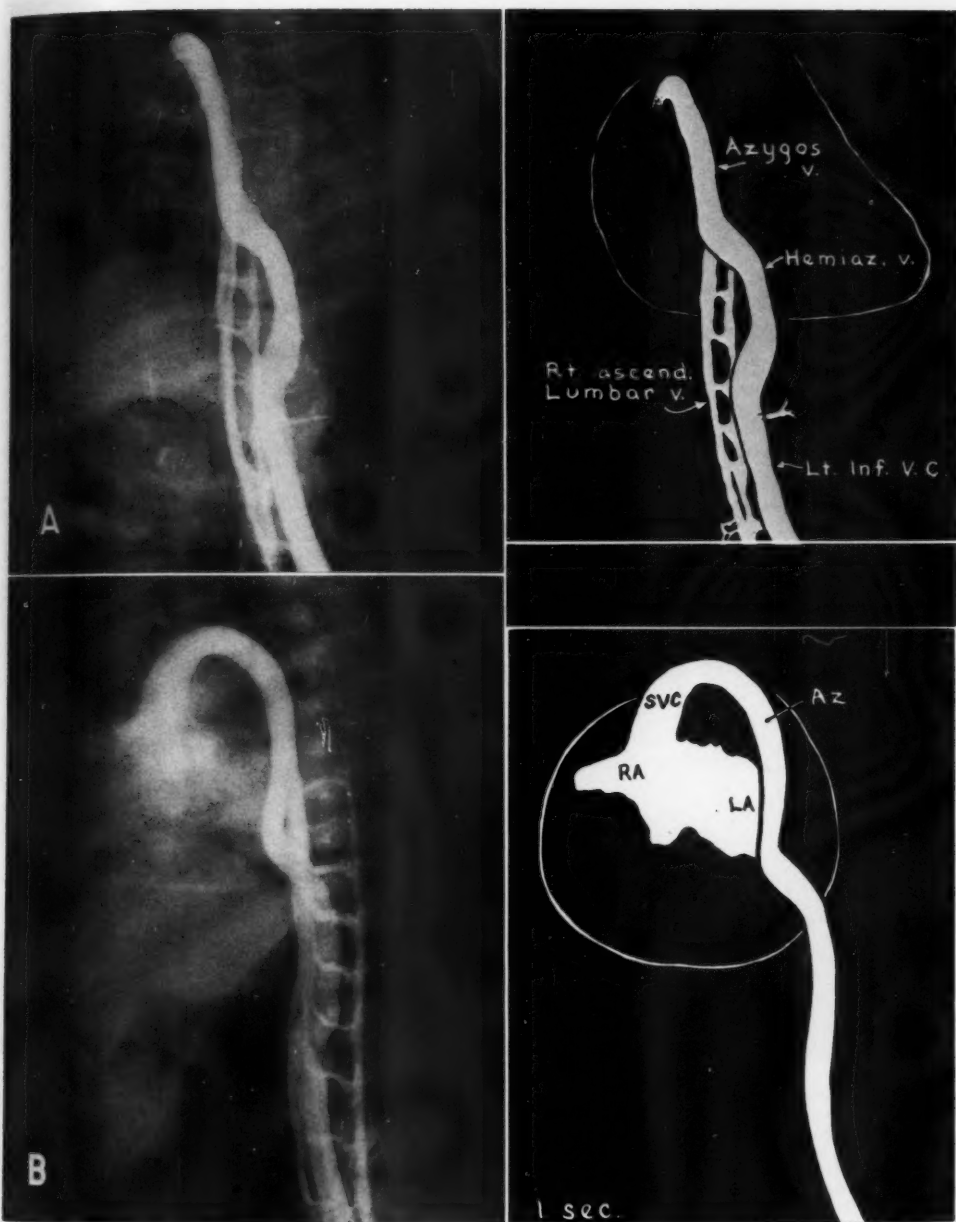


Fig. 14. Variations in the systemic venous return: absence of the inferior vena cava. The hepatic portion of the inferior vena cava is absent, and the opaque medium has flowed into the hemiazygos vein, and thence into the azygos vein. The hemiazygos is a large channel, and is continuous with a left inferior vena cava below. The azygos vein empties into the superior vena cava, and thus blood from the lower extremities and abdomen reaches the right atrium.

A. Anteroposterior view.

B. Steep right posterior oblique projection.

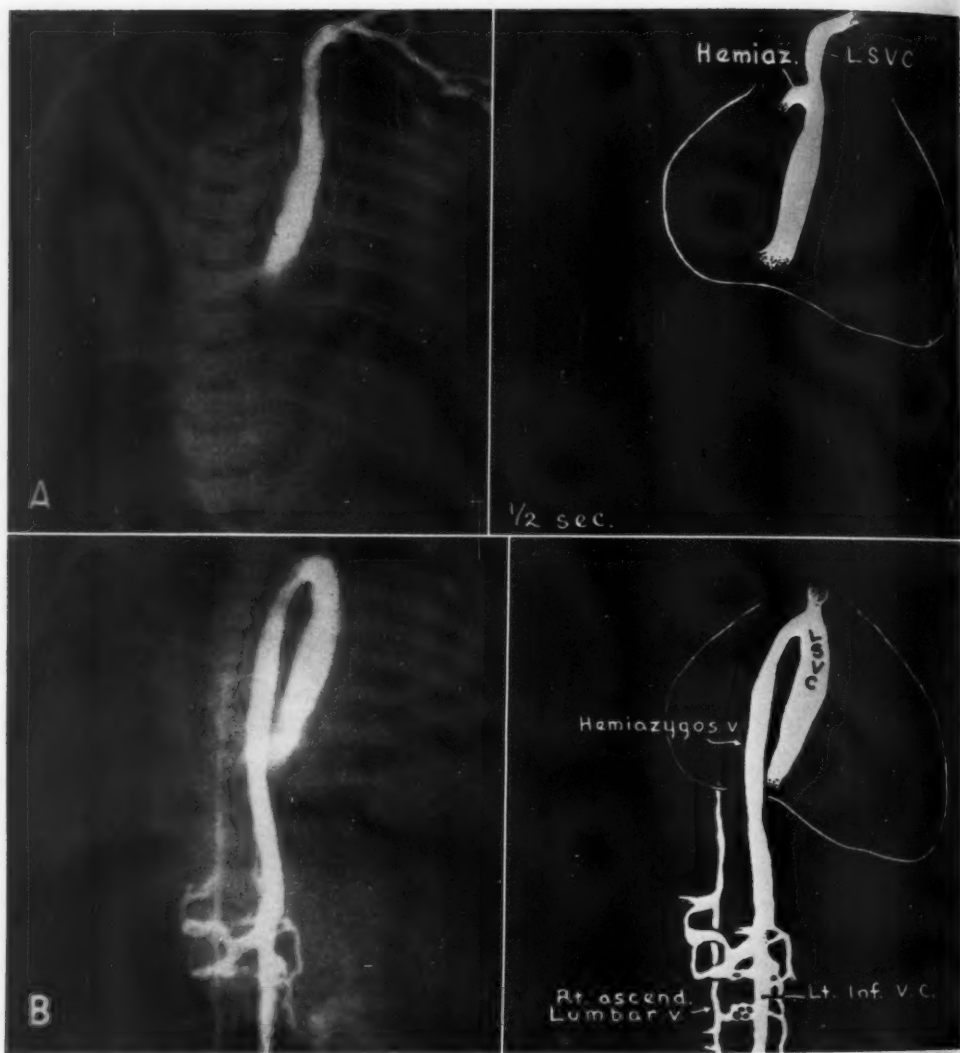


Fig. 15. Variations of systemic venous return: absence of the inferior vena cava associated with a persistent left superior vena cava.

A. Anteroposterior projection. Injection of the opaque medium into the left antecubital vein demonstrates opacification of the left superior vena cava, which empties into the right atrium at the coronary sinus. Minimal reflux into a large hemiazygos vein is present.

B. Anteroposterior projection. Following injection of the saphenous vein, a large venous trunk lying to the left of the abdomen is visible, ascending along the spine to join the left superior vena cava. This represents the lower portion of a left inferior vena cava, continuous with the hemiazygos vein. The hepatic portion of the inferior vena cava is absent. A rather small right ascending lumbar vein continuous with a small azygos vein is visible.

azygos systems in human infants, emphasis has been placed on the variability of the patterns observed. That this emphasis is appropriate has frequently been stressed by anatomists (41). In most instances,

little clinical significance is attached to the variations in venous return. Occasionally, however, knowledge of these variations may have important practical implications. In one instance, in which the

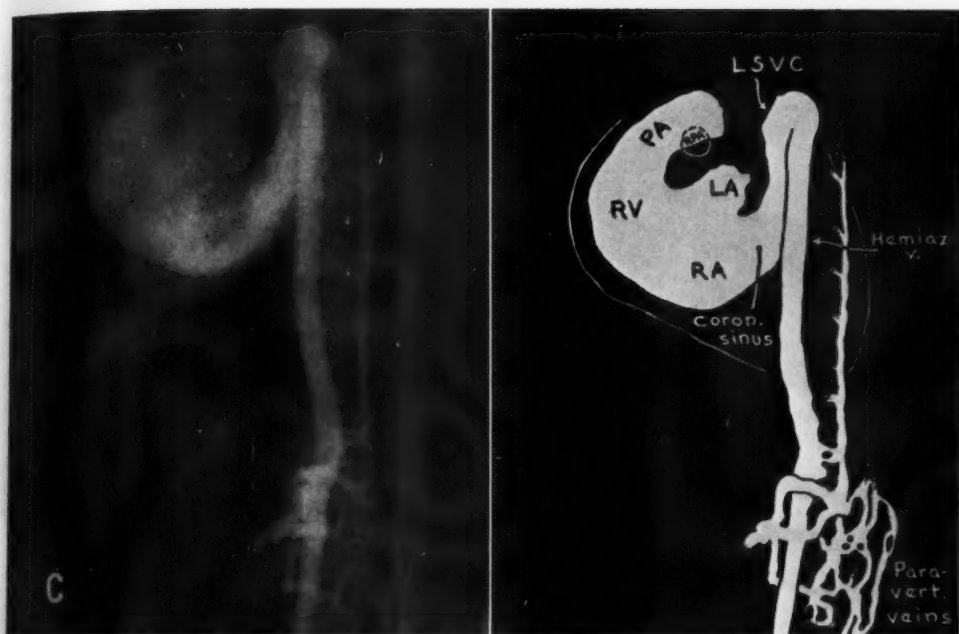


Fig. 15. Variations of systemic venous return: absence of the inferior vena cava associated with a persistent left superior vena cava.—*cont.*

C. Right posterior oblique projection. Injection into the left saphenous vein demonstrates the large hemiazygos trunk draining into the left superior vena cava, which then communicates directly with the right atrium through the coronary sinus. (LSVC. Left superior vena cava. Hemiaz. v. Hemiazygos vein.)



Fig. 16. Variations in systemic venous return: persistent left superior vena cava with anomalous drainage into the left atrium, anteroposterior projection. Following injection into the left antecubital vein, opacification of the left superior vena cava, the innominate vein, and to some degree of the right superior vena cava is noted. The left superior vena cava communicates directly with the left atrium and, after one second, left atrial and partial left ventricular opacifications are noted. (LSVC. Left superior vena cava. RSVC. Right superior vena cava. IV. Innominate vein. LA. Left atrium. LV. Left ventricle.)



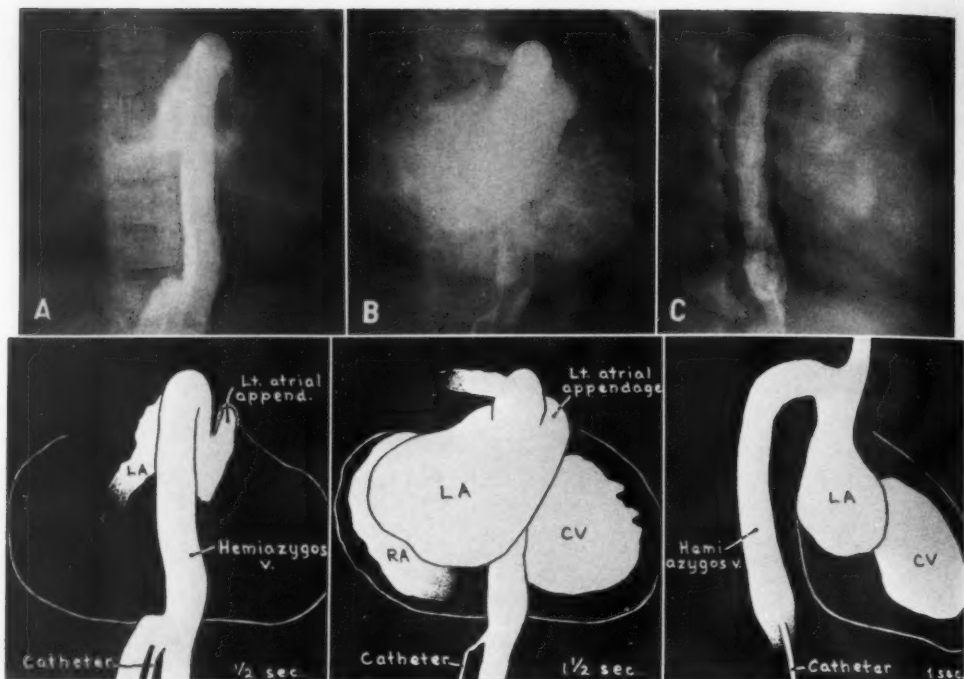


Fig. 17. Variations in systemic venous return: absence of the inferior vena cava associated with anomalous drainage of the hemiazygos vein into the left atrium.

A. Anteroposterior projection, one-half second after injection. The catheter is in the hemiazygos vein, which drains cephalad.

B. Anteroposterior projection, one and one-half seconds after injection. The hemiazygos vein empties directly into the left atrium, which communicates with the right atrium through a large atrial septal defect. The common ventricle is well filled.

C. Left posterior oblique projection, one second after injection. The unusual course of the hemiazygos vein bears some resemblance to that of the thoracic aorta. (RA. Right atrium. LA. Left atrium. CV. Common ventricle.)

hepatic portion of the inferior vena cava was absent and the venous drainage from the abdomen reached the right atrium through the azygos system and the superior vena cava, ligation of the azygos vein was followed by retroperitoneal hemorrhage and death (16). A major dual system of venous return from the lower portion of the body did not exist in this patient. Awareness of this possibility might have forestalled the surgical procedure.

In the approach to ligation of the inferior vena cava for pulmonary embolism, failure to find the vessel, or the finding of a small vessel on the right side, should suggest the possibility of persistent left inferior vena cava. In the presence of portal hypertension, a portacaval shunt might

be difficult or impossible if a left inferior vena cava were continuous with the hemiazygos vein. Furthermore, the portal blood flow would be shunted directly into the anastomotic system which builds up as a response to portal hypertension.

Where such an anomaly as vena caval insertion into the left atrium exists and causes cyanosis, surgical correction may be undertaken if the anatomy is clearly outlined (29).

Finally, a knowledge of some of the variations in venous anatomy may occasionally explain unusual clinical findings. Thus, it is not difficult to visualize unilateral development of a chest wall collateral circulation due to superior vena caval obstruction in the presence of

congenital hypoplasia or absence of the innominate vein; in such a situation, a route for left upper extremity blood to reach the inferior vena cava *via* the paravertebral and azygos veins has already been established. The cardiac physiologist, too, should be aware of the variations that occur; following cardiac catheterization through the saphenous vein, the unusual course taken by the catheter in the absence of an inferior vena cava may otherwise be a vexing source of puzzlement. In one case which we have observed, both the cephalad portion of the superior vena cava and the innominate vein were atretic. Prior knowledge of these anomalies permitted the radiologist to suggest that catheterization be done from below. This was successfully accomplished.

#### SUMMARY

1. Following injection of opaque medium into the saphenous or femoral veins in infants, opacification of the vertebral and azygos venous systems was noted in about two-thirds of 40 cases. The studies demonstrated the plexiform nature of the vertebral veins, and the extensive interconnections of the vertebral, azygos, and caval systems.

2. Some aspects of the normal radiologic anatomy of the vertebral and azygos systems are described and illustrated.

3. Many variations in the anatomy of the systemic venous return occur. A number of these are illustrated and their implications discussed.

4. The ease with which the vertebral veins may be opacified during angiocardiac study from below, and the extent of opacification observed at times, supports Batson's concept that the direction of flow of blood in these veins may be reversible and may be altered by changes in intrathoracic or intra-abdominal pressure.

Stanford University School of Medicine  
San Francisco 15, Calif.

#### REFERENCES

1. ABRAMS, H. L., AND KAPLAN, H. S.: Angiocardiac Interpretation in Congenital Heart Disease. Springfield, Ill., Charles C Thomas, 1956.
2. ANDERSON, R. K.: Diodrast Studies of the Vertebral and Cranial Venous Systems to Show Their Probable Role in Cerebral Metastases. *J. Neurosurg.* **8**: 411-422, July 1951.
3. ANDREASEN, A. T., AND WATSON, F.: Experimental Cardiovascular Surgery. *Brit. J. Surg.* **39**: 548-551, May 1952.
4. ANSON, B. J., AND CAULDWELL, E. W.: The Pararenal Vascular System: The Study of 425 Anatomical Specimens. *Quart. Bull., Northwestern Univ. M. School* **21**: 320-328, 1947.
5. ARONSSON, H.: Vertebral Venous System and Its Clinical Importance. *Nord. med.* **33**: 268-269, Jan. 24, 1947.
6. BATSON, O. V.: Function of Vertebral Veins and Their Role in Spread of Metastases. *Ann. Surg.* **112**: 138-149, July 1940.
7. BATSON, O. V.: The Role of the Vertebral Veins in Metastatic Processes. *Ann. Int. Med.* **16**: 38-45, January 1942.
8. BATSON, O. V.: The Vertebral Vein System as a Mechanism for the Spread of Metastases. *Am. J. Roentgenol.* **48**: 715-718, December 1942.
9. BOCK, A. C.: Darstellung der Venen des menschlichen Körpers nach ihrer Structur, Vertheilung und Verlauf. Leipzig, Baumgärtner, 1823.
10. BURKE, D. T., AND GOLDBERG, L.: Azygos Vein in Tomography. *Canad. M. A. J.* **60**: 271-272, March 1949.
11. BUTLER, H., AND BALANKURA, K.: Preaortic Thoracic Duct and Azygos Veins. *Anat. Rec.* **113**: 409-419, August 1952.
12. CAMPBELL, M., AND DEUCHAR, D. C.: The Left-Sided Superior Vena Cava. *Brit. Heart J.* **16**: 423-439, October 1954.
13. COHN, T. D., KRINSKY, M., AND ZAROWITZ, H.: Metastatic Brain Abscess: Role of Vertebral Vein Circulation. *Am. Pract. & Digest Treat.* **1**: 792-794, August 1950.
14. COMAN, D. R., AND DE LONG, R. P.: Role of Vertebral Venous System in Metastasis of Cancer to Spinal Column; Experiments with Tumor-Cell Suspensions in Rats and Rabbits. *Cancer* **4**: 610-618, May 1951.
15. DOWNING, D. F.: Absence of the Inferior Vena Cava. *Pediatrics* **12**: 675-680, December 1953.
16. EFFLER, D. B., GREER, A. E., AND SIFERS, E. C.: Anomaly of the Vena Cava Inferior: Report of Fatality after Ligation. *J.A.M.A.* **146**: 1321-1322, Aug. 4, 1951.
17. FISCHGOLD, H., ADAM, H., ECOIFFIER, J., AND PIEQUET, J.: Opacification des plexus rachidiens et des veines azygos par voie osseuse. *J. de radiol. et d'électrol.* **33**: 37, 1952.
18. FLEISCHNER, F. G., AND UDIS, S. W.: Dilatation of Azygos Vein; a Roentgen Sign of Venous Engorgement. *Am. J. Roentgenol.* **67**: 569-575, April 1952.
19. FLYNN, R.: Congenital Stricture of Esophagus. *M. J. Australia* **1**: 702-703, May 18, 1946.
20. FRANKLIN, K. J.: A Monograph on Veins. Springfield, Ill., Charles C Thomas, 1937.
21. GARDNER, D. L., AND COLE, L.: Long Survival with Inferior Vena Cava Draining into Left Atrium. *Brit. Heart J.* **17**: 93-97, January 1955.
22. HALPERN, M. H.: Azygos Vein System in Rat. *Anat. Rec.* **116**: 83-93, May 1953.
23. HAMILTON, H. B., AND MEADER, R. G.: Anomalous Single Azygos-Hemiazygos Vein Associated with Retroaortic Left Renal and Accessory Renal Veins. *Yale J. Biol. & Med.* **14**: 463-468, May 1942.
24. HARRIS, H. A.: A Note on the Clinical Anatomy of the Veins, with Special Reference to the Spinal Veins. *Brain* **64**: 291-300, December 1941.
25. HELANDER, C. G., AND LINDHOM, Å.: Sacro-

lumbar Venography. *Acta radiol.* **44**: 410-416, November 1955.

26. HERLIHY, W. F.: Revision of Venous System; Role of Vertebral Veins. *M. J. Australia* **1**: 661-672, May 31, 1947.

27. HILTON, J.: Quoted by Norgore (36).

28. HOWARTH, F., AND COOPER, E. R. A.: Departure of Substances from Spinal Theca. *Lancet* **2**: 937-940, Nov. 19, 1949.

29. HURWITT, E. S., ESCHER, D. J., AND CITRIN, L. I.: Surgical Correction of Cyanosis Due to Entrance of Left Superior Vena Cava into Left Auricle. *Surgery* **38**: 903-914, November 1955.

30. JOHNSTONE, A. S.: Experimental Study of Vertebral Venous System; Preliminary Report. *Proc. Roy. Soc. Med.* **39**: 538-540, July 1946.

31. LATIMER, H. B., AND VIRDEN, H. H.: A Case of Complete Absence of Inferior Vena Cava. *J. Kansas M. Soc.* **45**: 346-347, October 1944.

32. LAWRENCE, E. A., AND MOORE, D. B.: Study of Importance of Vertebral Venous System in Metastasis of Neoplasms as Demonstrated by Transplantable Rabbit Carcinoma. *S. Forum* (1951), pp. 269-276, 1952.

33. LESSMANN, F. P., SCHOBINGER VON SCHOWINGEN, R., AND LASSER, E. C.: Intra-Osseous Venography in Skeletal and Soft Tissue Abnormalities. *Acta radiol.* **44**: 397-409, November 1955.

34. MELLINS, H. Z.: Functions of the Vertebral Venous System. *Bull. Univ. Minn. Hosp., Minn. M. Found.* **22**: 213-224, January 19, 1951.

35. NORDENSTRÖM, B.: Method of Angiography of the Azygos Vein and the Anterior Internal Venous Plexus of the Spine. *Acta radiol.* **44**: 201-208, September 1955.

36. NORGORE, M.: Clinical Anatomy of the Vertebral Veins. *Surgery* **17**: 606-615, April 1945.

37. NORTHWAY, R. O., AND GREENWAY, G. D.: The Vena Cava and its Collateral Circulation. *Univ. Hosp. Bull., Ann Arbor* **10**: 67-69, September 1944.

38. QUAIN, J.: *Elements of Descriptive and Practical Anatomy.* London, Simpkin & Marshall, 1828.

39. ROBINSON, L. S.: The Collateral Circulation Following Ligation of the Inferior Vena Cava: Injection Studies in Stillborn Infants. *Surgery* **25**: 329-347, March 1949.

40. SALÉN, E. F.: A Phlebographic Study of Constructive Processes in the Superior Vena Cava Area and of Accompanying Changes in the Collateral Circulation. *Acta radiol.* **36**: 81-87, July 1951.

41. SEIB, G. A.: Azygos System of Veins in American Whites and American Negroes, Including Observations on Inferior Caval Venous System. *Am. J. Phys. Anthropol.* **19**: 39-163, April-June 1934.

42. STACKELBERG, B., LIND, J., AND WEGELIUS, C.: Absence of Inferior Vena Cava Diagnosed by Angiocardiography. *Cardiologia* **21**: 583-589, 1952.

43. STAUFFER, H. M., LABREE, J., AND ADAMS, F. H.: Normally Situated Arch of the Azygos Vein; Its Roentgenologic Identification and Catheterization. *Am. J. Roentgenol.* **66**: 353-360, September 1951.

44. SÖSSE, H. J., AND AURIG, G.: Das transossale Venogramm der Venae intercostales, der Vena azygos und der Vena thoracica interna. *Fortschr. a. d. Geb. d. Röntgenstrahlen* **81**: 335-345, September 1954.

45. TAUSSIG, H. B.: Congenital Malformations of the Heart. New York, Commonwealth Fund, 1947.

46. TORI, G.: Dimostrazione delle vene azygos, emiazigos, lombari con flebografia perossale, *Nuntius radiol.* **19**: 724-728, September 1953.

47. TORI, G.: The Radiological Demonstration of the Azygos and Other Thoraco-Abdominal Veins in the Living. *Brit. J. Radiol.* **27**: 16-22, January 1954.

48. WILLIS: Quoted by Harris (24).

49. WINSLOW: Quoted by Harris (24).

50. WINTER, F. S.: Persistent Left Superior Vena Cava: Survey of World Literature and Report of 30 Additional Cases. *Angiology* **5**: 90-132, April 1954.

#### SUMMARY IN INTERLINGUA

#### Le Systemas del Vena Vertebral e del Vena Azygos e Certe Variationes in le Systemic Retorno Venose

In le curso del passate quatro annos, le autor ha effectuate un numero de injectiones angiocardigraphic via le venas saphen o femoral. Le analyse de quaranta studios consecutive in patientes pediatric de etates de inter vinti-sex dies e quatro annos revela que grados significative de opacification del systemas del venas vertebral e azygos esseva effectuate in circa duo tertios del patientes. Tal studios demonstra le natura plexiforme del venas vertebral e le extense interconnexiones del systemas del venas vertebral, azygos, e caval. Illos etiam indica que multe variationes occurre in le anatomia normal del systemic retorno venose e suggere que le systema venose vertebral es un

reservoir de immagasinage e non solmente un canal de drainage.

Le facilitate con que le venas vertebral pote esser opacificate in studios angiocardigraphic ab infra e le grado del opacification que es a vices observate supporta le conception que le direction del fluxu sanguinee in le venas vertebral es possibilemente reversibile e pote esser alterate per alterationes del pression intrathoracic o intra-abdominal.

In le majoritate del casos pauc signification clinic es a trovar in variationes del retorno venose, sed il existe situationes in que le cognoscentia de iste variationes pote haber importante consequentias practice e pote explicar constataciones inusual.

## Studies with Radioiodine

### VI. Evaluation of Radioiodine Treatment of Carcinoma of the Thyroid Based on the Experience at the University of California from 1938 to 1954<sup>1</sup>

GLENN E. SHELINE, M.D., and EARL R. MILLER, M.D.

THE INITIAL clinical studies with radioactive iodine began at the University of California School of Medicine in 1938, when Drs. Joseph G. Hamilton and Mayo H. Soley administered  $I^{131}$  to patients with hyperthyroidism and to patients with carcinoma of the thyroid gland. Although they and others demonstrated that such therapy offered considerable promise in the treatment of hyperthyroidism, the experience in treating patients with thyroid carcinoma was disappointing, and these studies were held in abeyance for the next several years. During this period, numerous reports dealing with the use of radioiodine in carcinoma of the thyroid appeared in the literature. These reports showed that, while relatively few of these carcinomas took up significant quantities of administered radioiodine, some did respond to this therapy.

In the fall of 1945, the problem of radioiodine therapy of carcinoma of the thyroid was again taken under consideration. When the program was first resumed, the investigation consisted essentially of the administration of a test dose of  $I^{131}$ , followed by examination of the carcinomatous tissue for uptake of the isotope. A few attempts were made to influence the uptake by thyroidectomy or by the administration of thyroid-stimulating hormone (TSH); but, at least initially, the results were not very successful. As more patients were seen and studied, a few were found with tumors possessing an appreciable affinity for iodine. Thus interest grew, and a fairly intensive and systematic program evolved.

The primary aims were: (a) to treat patients suffering from carcinoma of the thyroid, (b) to develop ways and means of influencing thyroid cancer tissue to take up administered  $I^{131}$ , and (c) to study the possible adverse effects of the radiation in patients who received relatively large doses of radioiodine.

Several different approaches to the treatment of thyroid carcinoma with radioiodine were in use in various medical centers. In certain of these, patients were treated only after the establishment of a minimum degree of radioiodine uptake by the neoplastic tissue. In these cases the evaluation was often an indirect one, based on measurement of urinary excretion of  $I^{131}$ . In other centers patients with inoperable thyroid carcinomas were treated with equal doses of  $I^{131}$  administered at regular predetermined intervals, whether or not there was any demonstrable uptake by the neoplastic tissue. In fact, this regimen was used postoperatively as a means of prophylactic irradiation even when there was no known residual neoplastic tissue.

The basic program at the University of California Hospital in San Francisco lay somewhere between these two approaches. In the cases treated since the fall of 1949, when a systematic procedure was first instituted, the aim was to administer 100 millicuries of  $I^{131}$  per month as long as evidence of tumor avidity for  $I^{131}$  could be shown. In these cases total doses of several hundred millicuries were given, distributed over several months. Only patients with residual inoperable neo-

<sup>1</sup> From the Department of Radiology, University of California School of Medicine, San Francisco, Calif. This work was supported by the U. S. Atomic Energy Commission, the cancer research funds of the University of California, and the Cancer Research Institute of the University of California School of Medicine, San Francisco. Accepted for publication in April 1957.



plastic tissue were accepted for treatment, and, as a rule, they were treated only after the establishment of some degree of radioiodine uptake by the neoplastic tissue. At one time thyroidectomizing doses of  $I^{131}$  were administered to a limited number of patients in whom no residual carcinomatous tissue was known to be present. This was done following surgical thyroidectomy in order to complete thyroid ablation so that, should metastases or recurrence ultimately appear, the feasibility of  $I^{131}$  therapy could be evaluated without first having to complete destruction of the thyroid.

#### METHODS

**Selection of Patients:** Between September 1945 and June 30, 1954, 124 patients with histologically proved primary carcinoma of the thyroid gland were studied. At the time of the initial visit, some had small undiagnosed masses in the thyroid while others had inoperable carcinoma with widespread metastases. All degrees of involvement between these extremes were represented. The age-sex distribution of these 124 patients is shown graphically in Figure 1. The histologic diagnoses are listed in Table I.

When possible, a 1- to 2-millicurie

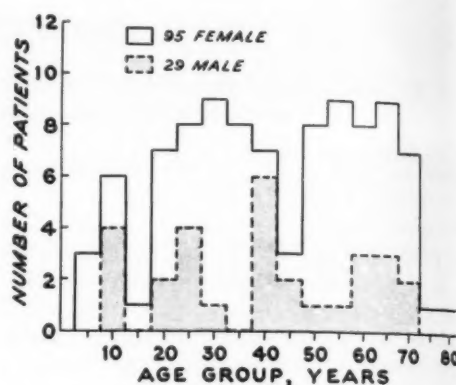


Fig. 1. Age-sex distribution of 124 patients with carcinoma of the thyroid studied in the Radioiodine Laboratory September 1945 to June 30, 1954.

test dose of  $I^{131}$  was administered twenty-four to forty-eight hours prior to surgery for suspected carcinoma. This allowed uptake studies to be made of the thyroid gland and of the operative specimens. A number of the patients, however, were referred to the Radioiodine Laboratory after surgery and presented no opportunity for the study of radioiodine in the surgical specimens.

Prior to July 1950, a patient was accepted for definitive treatment with radioiodine only if the residual neoplastic tissue took up a demonstrable amount of

TABLE I: HISTOPATHOLOGIC DIAGNOSIS AND NUMBER TREATED WITH  $I^{131}$ \* BEFORE AND AFTER JUNE 30, 1950

Pathologic Diagnosis	Before June 30, 1950		July 1, 1950-June 30, 1954	
	Total No. Studied	No. Treated with $I^{131}$	Total No. Studied	No. Treated with $I^{131}$
I. With residual carcinoma or metastases				
Adenocarcinoma	12	2	17	11
Papillary adenocarcinoma	26	2	13	7
Undifferentiated carcinoma	5	0	2	1
Giant cell carcinoma	3	0	1	0
Hürthle cell carcinoma	2	0	0	0
Unclassified carcinoma	3	0	2	0
II. No known tumor at time studied				
Adenocarcinoma	5	0	6	0
Papillary adenocarcinoma	5	0	13	0
Undifferentiated carcinoma	0	0	2	0
Giant cell carcinoma	0	0	0	0
Hürthle cell carcinoma	0	0	0	0
Unclassified carcinoma	0	0	0	0
III. With tumor, but not considered for treatment†	0	0	7	0

\* In those patients with residual carcinoma, the number treated with  $I^{131}$  indicates the number with  $I^{131}$  uptake, since all patients with appreciable uptake were treated.

† Patient refused treatment, patient died before study was concluded or treatment started, etc.



the first test dose of  $I^{131}$ . Little or no effort was made to influence the uptake. Experience soon showed that certain tumors took up  $I^{131}$  only after removal of the thyroid gland. After July 1950, therefore, the thyroids of all patients were ablated by surgery and/or radioiodine before a definite decision regarding tumor uptake was made. In most cases, surgery alone failed to accomplish complete ablation; these patients were given large doses of  $I^{131}$ . Six to eight weeks later uptake studies were repeated and, if necessary, additional  $I^{131}$  was administered to complete thyroid destruction. When it was determined that this had been accomplished, radioiodine uptake in the tumor was evaluated, directly by scanning with a counter and by examination of biopsy specimens, and indirectly by measurement of the forty-eight-hour urinary excretion of  $I^{131}$  to indicate the amount retained by the body.

A patient was selected for intensive treatment with radioiodine only (a) when carcinoma of the thyroid had been established histologically, (b) when residual inoperable carcinomatous tissue was present, and (c) when this residual tissue showed some evidence of concentrating radioiodine. Evidence of the tumor's avidity for  $I^{131}$  was considered sufficient if the forty-eight-hour urinary excretion was less than 90 per cent of the administered dose, or if scanning over a tumor with a counter showed a discernible localization of  $I^{131}$ . Thus, each patient for whom any possibility of gain from radioiodine therapy could be demonstrated was accepted for treatment.

*Method of Therapy:* Of the 124 patients with histologically proved carcinoma of the thyroid, 101 were studied but were not given  $I^{131}$  for tumor treatment, either because there was no demonstrable residual tumor or because no discernible tumor uptake could be demonstrated. These patients were given thyroid extract as needed to keep them euthyroid and then were followed for possible recurrence or for evidence of tumor avidity for radio-

iodine. Fourteen of the 101 received one or two doses of 25 to 50 millicuries of  $I^{131}$  to complete the destruction of the thyroid gland, even though there was no residual tumor. This group was then given thyroid extract and was followed for possible recurrence or late adverse effects from the radiation.

The remaining 23 patients had inoperable carcinomatous thyroid tissue that did concentrate radioiodine. Definitive  $I^{131}$  therapy was instituted for each of these; 18 patients completed the projected course of therapy; the remaining 5 died before the course was finished or were too ill to come in for treatment.

The general plan of therapy was to administer orally 100 millicuries of carrier-free  $I^{131}$  at monthly intervals until there was no evidence of tumor uptake or until severe injury, usually of the hematopoietic system, precluded further treatment. The patients in this group were then followed for a time without the administration of thyroid extract. They were examined monthly for both radiation effects and tumor uptake. If, after one to four months, no further uptake occurred, thyroid extract was given to relieve the usually severe state of myxedema.

*Attempts to Influence Tumor Avidity for  $I^{131}$ :* On the assumption that myxedema provides a physiological stimulus to tumor function, probably through the endogenous production of TSH, complete ablation of the thyroid gland was done in an attempt to increase the avidity of the tumor for  $I^{131}$ . Occasionally, in addition, courses of thiouracil or propylthiouracil were administered, with doses of 0.15 to 1.5 gm. per day for periods up to ten weeks. Tumor avidity for  $I^{131}$  was then evaluated approximately forty-eight to seventy-two hours after the last dose. With rare exceptions, thiouracil and its derivatives were of little avail. Several patients were given TSH, and tumor avidity for  $I^{131}$  was re-evaluated. In some instances a course of TSH consisted of 10 units per day given intramuscularly for three days; in others, the TSH was given intravenously

TABLE II: SUMMARY OF INFORMATION REGARDING THE 18 PATIENTS WHO COMPLETED A COURSE OF  $I^{131}$  THERAPY FOR CANCER OF THE THYROID

Case No. Age, Sex	Tumor	Metastases	Prior to $I^{131}$	Treatment with $I^{131}$			Status 12/54†	Months Elapsed‡	Comment
				Year	Total (mc.)	No. of Doses			
I M 10	Adenocarcinoma	Lungs	S	1950	433	4	A +	96	1950: Treated with $I^{131}$ . Me- tastases became smaller and cyanosis disappeared 1949-50: Temporary disap- pearance of pulmonary and pharyngeal lesions after $I^{131}$ Subcutaneous mass over manu- brum improved with $I^{131}$ but did not disappear No effect from $I^{131}$
II M 23	Papillary adeno- carcinoma	Lungs, pharynx	S, X	1947 1949 1952	94 350 98	1 3 1	D + (10/52)	70	
III F 60	Papillary adeno- carcinoma	Cervical lymph nodes; subcutaneous	X	1952	492	5	D + (4/54)	50	
IV F 64	Adenocarcinoma	Mediastinum; cervi- cal lymph nodes	X, S	1952	506	6	D + (1/53)	10	
V F 49	Adenocarcinoma	Cervical lymph nodes; lungs	S	1950- 51 1953	634 211	6 2	D + (11/54)	53	1951: Metastases became smaller after $I^{131}$ but later recurred in lungs and else- where
VI F 30	Adenocarcinoma	Cervical lymph nodes	S	1951	98	2	A°	47	After $I^{131}$ lymph nodes showed cancer with marked radia- tion injury
VII F 43	Papillary adeno- carcinoma	Sternum; rib	S, X	1951	304	4	D + (6/54)	40	No discernible effect of $I^{131}$ on large masses of tumor
VIII F 50	Adenocarcinoma	Femur	S, X	1951	197	3	D + (3/52)	17	Good $I^{131}$ uptake in femoral metastasis
IX F 68	Adenocarcinoma	Cervical lymph nodes	0	1950- 51	565	8	A +	48	Reduction in size of tumor and no regrowth 3 1/2 years after $I^{131}$
X F 42	Anaplastic adeno- carcinoma	Cervical lymph nodes	S	1951	290	3	D + (1/52)	4	No tumor response to $I^{131}$
XI M 11	Papillary adeno- carcinoma	Cervical lymph nodes	S	1951	250	4	A°	45	Patient has remained well
XII F 67	Papillary adeno- carcinoma	Cervical lymph nodes; lungs	S	1952	223	3	A +	30	Tumor became smaller after $I^{131}$ . Inactive 2 1/2 years later
XIII F 60	Papillary adeno- carcinoma	Cervical lymph nodes; lungs; rib	S, X	1951 1953	594 100	7 1	D + (1953)	24	No growth during 1 year after $I^{131}$ , 1953: New metastases and death within 1 month
XIV F 33	Papillary adeno- carcinoma	Cervical lymph nodes	S	1952	113	2	A°	34	Residual tumor treated with $I^{131}$ . No recurrence in 2 1/2 years

TABLE II: SUMMARY OF INFORMATION REGARDING THE 18 PATIENTS WHO COMPLETED A COURSE OF  $I^{131}$  THERAPY FOR CANCER OF THE THYROID (CONT.)

Case No. Sex Age	Tumor	Metastases	Prior to $I^{131}$ *	Treatment with $I^{131}$			Status 12/54†	Months Elapsed‡	Comment
				Year	Total (mc.)	No. of Doses			
XV F 66	Undifferentiated carcinoma	Pharynx; skull	S, X	1952	383	5	D + (9/52)	7	$I^{131}$ had no effect
XVI F 61	Papillary adenocarcinoma	Cervical lymph nodes; lungs	S	1952	378	4	L +	40	Lost to follow-up in 1952, when tumors were growing and new metastases appearing
XVII F 71	Adenocarcinoma	Cervical lymph nodes	0	1952-53	985	10	A +	29	TSH increased tumor uptake of $I^{131}$ . Marked decrease in tumor size after $I^{131}$
XVIII M 13	Adenocarcinoma	Cervical lymph nodes; lungs	S	1953	523	5	A +	21	Lung metastases became smaller and fewer in number after $I^{131}$ . Patient maturing normally

\* S. Surgery. X. X-ray. 0. None.

† A. Alive. D. Dead. L. Lost to follow-up.

‡ Months elapsed between treatment with  $I^{131}$  and December 1954 or death.

over an eighteen-hour period daily for three to eighteen days.

*Studies of Side Effects Associated with  $I^{131}$  Administration:* When patients are given large doses of  $I^{131}$ , harmful side effects may result directly from the radiation or indirectly from the radiation-induced hypothyroidism. To study these side effects, in addition to the usual history, physical examination, diagnostic roentgenography, and determinations of basal metabolic rate and serum protein-bound iodine, the following laboratory studies were made:

The hematopoietic system was evaluated by complete blood counts and bone marrow aspiration studies. Determinations of serum cholesterol, serum protein (albumin, globulin, and total), thymol turbidity, and Bromsulphalein excretion were used as tests of liver function. Renal function was evaluated by creatinine clearance and Addis concentration studies. Serum uric acid determinations served as a general test for tissue breakdown. This panel of studies preceded the administration of the initial large dose of  $I^{131}$ . For patients receiving multiple therapeutic doses, it was repeated at intervals of one or two months throughout the entire course of therapy and, frequently, for several months thereafter. For one patient who received a total dose of 1,000 millicuries, the group of studies was repeated forty-eight months after the conclusion of therapy.

Since, after more than two years of observation on this rather intensive basis, no abnormalities were demonstrated by the liver and kidney function tests that could be related definitely to the effects of radiation, these tests were discontinued.

*Radioiodine Detection:* Initially, determinations of the uptake of  $I^{131}$  in tumor tissue and in the thyroid were made with Geiger-Müller tubes and standard scaler circuits. Beginning in January 1951, the apparatus was modified to include a scintillation counter, the output of which was determined by a scaler circuit and a counting rate meter. The output of the counting rate meter was, in turn, fed to

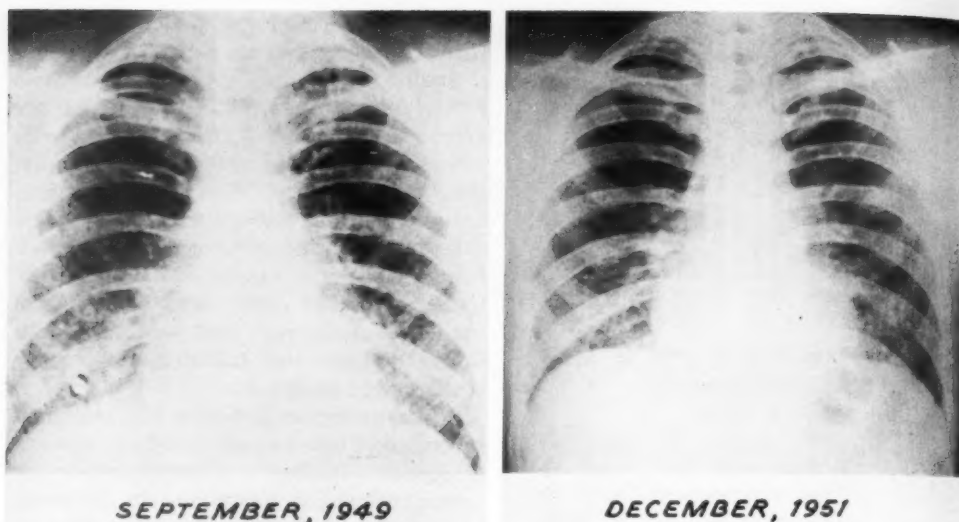


Fig. 2. Roentgenograms showing disappearance of widespread pulmonary lesions in a 28-year-old male after treatment with 350 millicuries of  $I^{131}$ . Case II.

an Esterline-Angus and later a Speedomax recorder. A motor-propelled crystal detector assembly mounted on a scanning rack was used as a radioiodine localizing device. A series of lead collimating cones of different geometries and degrees of collimation were available. The counting equipment and the characteristics of the collimators are described in detail elsewhere (1). When tissue was available, the radioiodine content and distribution were determined by counting and/or by radioautography.

#### RESULTS AND DISCUSSION

*Tumor Response and Status of the Patients Completing Therapy:* The Appendix contains brief histories of 5 of the 18 patients who completed the definitive course of therapy for carcinoma of the thyroid.<sup>2</sup> Table II is a summary of the more pertinent information regarding treatment doses, results, and the present status of this group. From the table it may be seen that, as of Dec. 31, 1954, 9 patients had died, 1 was lost to follow-up while known still to have carcinoma in the

cervical lymph nodes and is presumed to be dead, 8 were still living (twenty-four to ninety-six months after beginning  $I^{131}$  therapy). Of these 8 survivors, 5 were known to have carcinomatous masses.

In 11 of the 18 patients completing therapy there was objective evidence either of tumor regression or of arrest of growth. Of these 11, 7 subsequently died of thyroid carcinoma. One patient was alive with a known tumor which decreased markedly after  $I^{131}$  therapy and then remained unchanged in gross appearance for two and a half years. In the remaining 3 patients, the tumors disappeared and had not recurred (thirty to forty-six months after the last  $I^{131}$  therapy). It seems fair to conclude that there was some degree of palliation provided for each of these 11 patients. There still remains a possibility of cure for 3 of them.

In the remaining 7 patients there was no evidence of tumor regression or arrest. In 1 there was evidence of cellular destruction due to radiation, but the carcinomatous masses grossly were unchanged and the patient later died of his disease. Another patient of this group was lost to follow-up but almost certainly died of carcinoma,

<sup>2</sup> The remaining 13 case histories are available from the authors on request.



Fig. 3. Marked decrease in size of a subcutaneous mass over the manubrium protruding from the anterior chest wall after the administration of a total of 492 millicuries of  $I^{131}$ . Ulceration, which occurred during therapy, subsequently was partially healed. Case III.

with no evidence of benefit from the treatment. One patient (Case VIII) died of pulmonary metastases from a fibrosarcoma of the thigh, without evidence at autopsy of residual thyroid carcinoma. Possibly this case should not be included in the series, since, in retrospect, it is not certain that any of her metastatic tumor tissue at the time of radioiodine therapy had originated in the thyroid. It is of interest that the primary fibrosarcoma occurred over the site of a metastatic carcinoma of the thyroid in the femur which had persisted for ten years following rather heavy roentgen therapy.

Figures 2 to 5 graphically demonstrate the tumor response obtained in 4 of the treated patients. Figure 2 shows the roentgenologic disappearance of widespread pulmonary lesions in a 28-year-old male after the administration of 350 millicuries of  $I^{131}$ . Ultimately metastases reappeared in the lungs. Since death occurred before retreatment could be started, it is not known whether or not these would have responded to therapy. Figure 3 shows the marked diminution in size of a subcutaneous mass after the

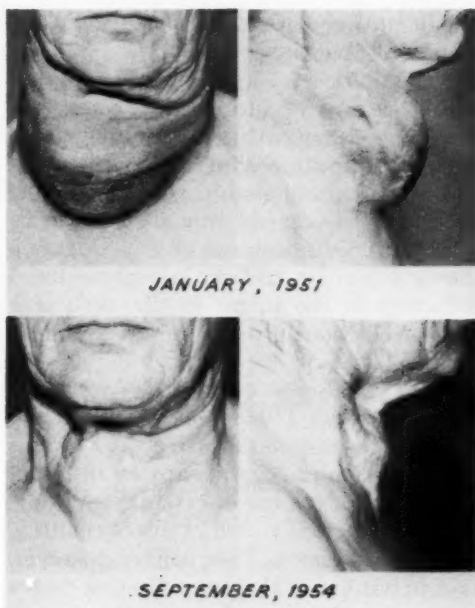


Fig. 4. Tumor response to a total of 554 millicuries of  $I^{131}$  is shown vividly in this patient (Case IX). The carcinomatous neck mass is shown as it appeared one month before  $I^{131}$  treatment was started (upper views). Two months later it had decreased to one-third of its original size. No regrowth had occurred as late as September 1954, three years after therapy (lower views).

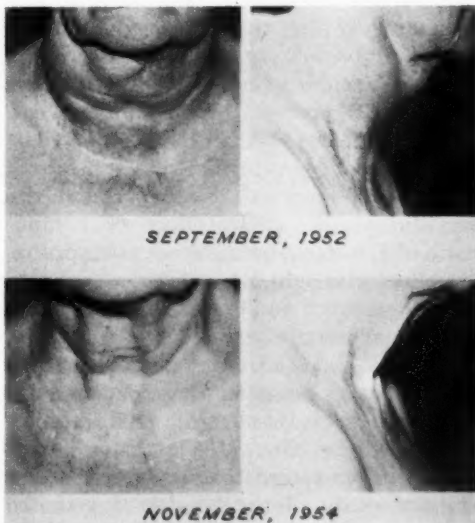


Fig. 5. Gradual but definite reduction in size of a cervical carcinomatous mass over a period of one year after treatment with a total of 985 millicuries of  $I^{131}$ . Case XVII.



administration of 492 millicuries of  $I^{131}$ . There was evidence of localized uptake of  $I^{131}$  in this mass. Ulceration of the tumor which occurred during the course of therapy subsequently underwent partial but not complete healing. Figure 4 shows a two-thirds reduction in the mass in the neck of a 68-year-old woman after treatment with 554 millicuries of  $I^{131}$ . Figure 5 shows a similar though less pronounced reduction in the tumor in the neck of a 72-year-old woman who received 985 millicuries of  $I^{131}$ .

*Effect of Thyroid Ablation and Drugs on Tumor Uptake:* It has proved exceedingly difficult to assess the effect of various procedures on radioiodine uptake in tumor tissue despite the use of external counting, of radioautography, and of direct counting of biopsy specimens. We believe, however, that in our hands the most effective means of increasing the uptake of radioiodine in tumors has been complete thyroidectomy. No attempt is made to estimate the proportion of patients with thyroid carcinoma whose tumors will develop  $I^{131}$  affinity after thyroidectomy, but 2 cases are presented which show that this type of response does occur and that it can occur rapidly after thyroidectomy.

The first of these patients was a 21-year-old woman who was known to have had a mass in the thyroid for one year. At the time of her initial visit to the Radioiodine Laboratory the cervical lymph nodes were enlarged bilaterally and she was euthyroid. A test dose of 1 millicurie of  $I^{131}$  was administered, and approximately forty-eight hours later a complete thyroidectomy and right radical neck dissection were carried out. All tissue specimens obtained were checked with a Geiger-Müller counter, and radioautographs were made of tissue from the primary lesion in the thyroid gland and from each of three carcinomatous lymph nodes. Careful study of the specimens revealed no evidence of radioiodine either in the primary carcinoma or in any of the nodes. Sixteen days after thyroidectomy the patient was given a second test dose.

The next day a left radical neck dissection was carried out and five lymph nodes containing metastatic thyroid cancer were obtained. Assay of these nodes demonstrated  $I^{131}$  in the lesions in each; the maximum concentration found represented 0.48 per cent of the administered dose per gram of tissue. To ascertain that the thyroidectomy had been complete, a third test dose of  $I^{131}$  was given about six weeks later. At this time no  $I^{131}$  localization was demonstrable in the neck.

The second of these patients was a 7-year-old girl with bilateral cervical adenopathy. The surgically removed primary carcinoma and four lymph nodes containing metastases which were obtained simultaneously with a complete thyroidectomy, failed to show radioiodine localization. Twelve days later about 16 per cent of a dose of  $I^{131}$  was taken up by the residual tumor in the neck. At autopsy on the fourteenth postoperative day, the neoplastic tissue of each of three lymph nodes was found to contain appreciable quantities of  $I^{131}$ . No non-neoplastic tissue could be found, indicating that the 16 per cent uptake in the neck area truly represented uptake by neoplastic tissue. The death in this case was sudden, and a thorough autopsy examination failed to reveal the cause.

TSH was administered either intravenously or intramuscularly to 15 patients. Fourteen received 10 units per day on three successive days, with no discernible influence on the uptake of radioiodine in the tumor tissue. Most of these 14 patients had either papillary adenocarcinoma or alveolar adenocarcinoma. The fifteenth patient had an alveolar adenocarcinoma of the thyroid with metastases to the right side of the neck; before the use of TSH these metastases had a 24-hour uptake of about 1 per cent of the dose of  $I^{131}$ . This patient was given 10 units of TSH per day in a slow intravenous drip; the flow was adjusted so that this required about eighteen hours per day. On the eighteenth day the twenty-four-hour tumor uptake had increased to 17 per cent, and the

forty-eight hour urinary excretion of  $I^{131}$  had dropped from an initial 89 per cent to 36 per cent of the administered dose.

Thiouracil (up to 1,800 mg. per day) was given to 2 patients with no effect on uptake. Several patients were treated with propylthiouracil but only one showed a significant response. She received 1 gram per day for twenty-eight days, followed

hypothyroidism or myxedema usually was induced early in the course of therapy and because patients varied markedly in age, physical condition, and extent of carcinomatous invasion. These factors in themselves may influence the laboratory tests for hepatic, renal, and hematopoietic function. Thus, it becomes necessary to analyze the data for each patient individu-

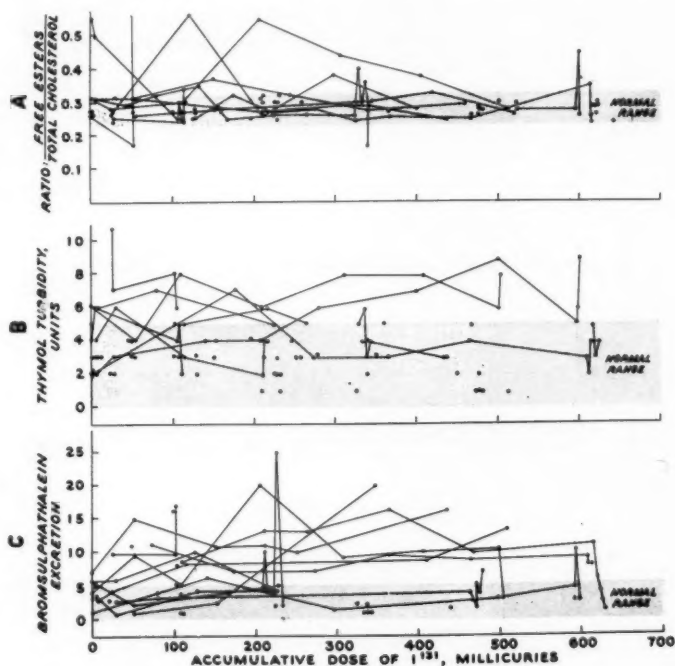


Fig. 6. Results of tests of hepatic function in 22 patients, each of whom received a total dose of 100 millicuries of  $I^{131}$  or more.

by 1.5 gm. per day for an additional fourteen days, with the result that the tumor uptake increased from an initial 5 per cent to a final 15 per cent of the administered dose.

Tapazole (10 mg. three times a day for twenty-one days) in one patient resulted in a slight but recognizable uptake in pulmonary lesions when no such uptake had been detected before administration of the drug.

**Adverse Effects of Radioiodine:** Efforts to evaluate adverse effects of the radiation from  $I^{131}$  were hampered because severe

ally, and it is difficult to ascertain if the effects noted were due to irradiation with  $I^{131}$  or to other factors.

**Effects of  $I^{131}$  on Hepatic and Renal Function:** The data in Figures 6 to 8 were obtained from 22 patients, each of whom received 100 millicuries or more of  $I^{131}$ . In these figures, the accepted limits for the normal range of values obtained in our laboratory are indicated. Whenever one or more values for a particular patient are outside the so-called normal range, all the values for this patient are connected by lines. Data for the remainder of the

patients are plotted as unconnected points.

From Figure 6,A, it is seen that 16 different values for the ratio of free ester to total cholesterol fall above the normal range. Two of these elevated values occur at doses of less than 10 millicuries, and there is no correlation between the degree of abnormality and the cumulative dose of  $I^{131}$ . About one-half of the patients had

no indication of a relationship between the abnormal values and the amount of  $I^{131}$  administered.

From Figure 7, it is seen that the values for serum globulin tend to lie in the upper half of the normal range, with a number of points falling above the normal limits. The reverse is true for the albumin values, the majority of which fall in the lower half

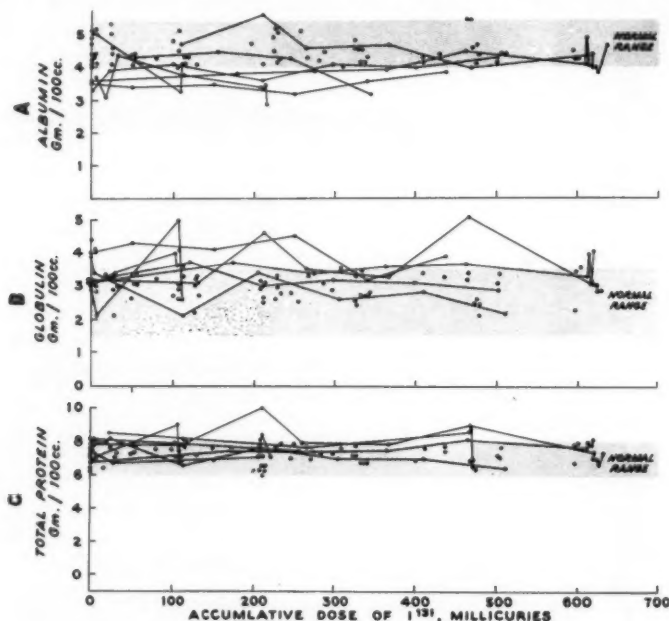


Fig. 7. Results of tests of hepatic function.

myxedema before treatment was started; in the others it developed before the first 100 millicuries of  $I^{131}$  were given. Thus it would seem more probable that these abnormal values are a result of the myxedematous state than of the  $I^{131}$  radiation. Consistent with the hypothesis that the abnormal values are due to some factor other than radiation damage is the fact that, regardless of dosage, all values for free esters and for total serum cholesterol were either elevated above the normal range or lay near the high limits of normal. The thymol turbidity data (Fig. 6,B) and the Bromsulphalein excretion data (Fig. 6,C) show a scattering of points in and above the normal range, but there is

of the normal range, with a number of points below the normal lower limits. As with the abnormal values for cholesterol, there is no discernible relation between the number of abnormal values or the degree of the abnormality and the cumulative  $I^{131}$  dose.

The majority of the values for creatinine clearance (Fig 8,A) fall in or below the lower portion of the normal range. Again there seems to be no relation between these values and the cumulative  $I^{131}$  dose. While certain abnormal values in these tests of hepatic and renal function were found for patients who received therapeutic doses of  $I^{131}$ , there was no correlation between the size of the dose and either the

number of abnormal values or the degree of abnormality. Thus it seems that a common denominator, aside from  $I^{131}$  dosage, must be sought.

The results of the quantitative twenty-four-hour Addis studies of the urine revealed no definite abnormality (Fig. 8,B). In no case was the pH or specific gravity outside the normal range. The

analysis of the results relating to the formed cellular elements of the peripheral blood, the values obtained for each patient<sup>3</sup> were plotted against the cumulative  $I^{131}$  dose. Smooth curves were drawn between the points for each patient, and the values for each 100-millicurie dose increment were selected from the curves.

In Figures 9 to 12, the average, maximum,

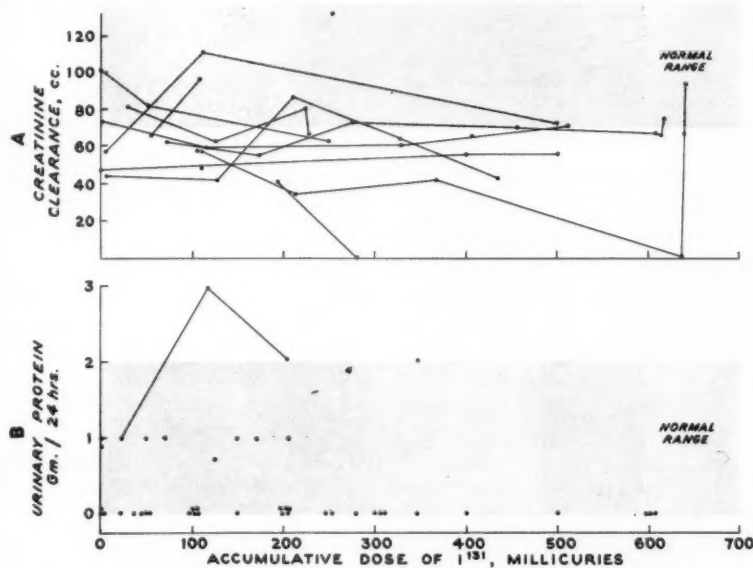


Fig. 8. Results of tests of renal function. A. Values for creatinine clearance plotted against a cumulative  $I^{131}$  dose. B. Addis concentration test, urinary protein (grams/24 hours) plotted against cumulative  $I^{131}$  dose (millicuries).

total number of casts and the quantity of protein in the urine during the twenty-four-hour period were always within normal limits. The majority of the patients were female and were ambulatory and it was not feasible to obtain catheterized urine specimens. Consequently, the total red cell and white cell counts of the urine were highly variable and could not be used. The myxedema present in most of these patients from early in the course of therapy is the most probable explanation for these abnormalities.

#### *Effect of $I^{131}$ on the Hematopoietic System:*

The hematopoietic data were obtained from 36 patients who received total doses of  $I^{131}$  in excess of 50 millicuries. For

and minimum values for the hemoglobin concentration, red cell, white cell, and platelet counts are plotted against the cumulative dose (0 to 600 millicuries of  $I^{131}$ ). It can be seen that for each dose a wide range of values was obtained, and that the average values gradually decreased with dosage. With a total of 600 millicuries of  $I^{131}$ , the average red cell count decreased from 4.7 to about 3.9, and the average hemoglobin concentration from 12.5 to 11.5. The average white cell

<sup>3</sup> Throughout this paper, the values for determinations of the formed cellular elements of the peripheral blood are expressed in terms of the following units: hemoglobin level, concentration in grams per 100 c.c.; red cells, count in millions per cu. mm.; white cells and platelets, count per cu. mm.

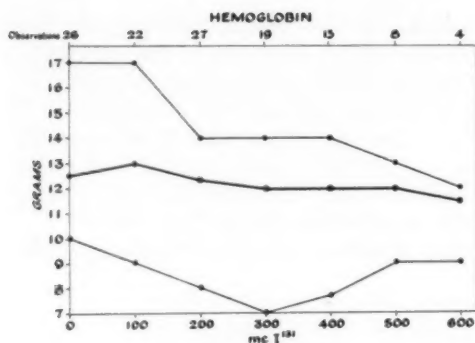


Fig. 9. Average, maximum, and minimum values for hemoglobin concentration for 36 patients who received total doses of more than 50 millicuries of  $I^{131}$ .

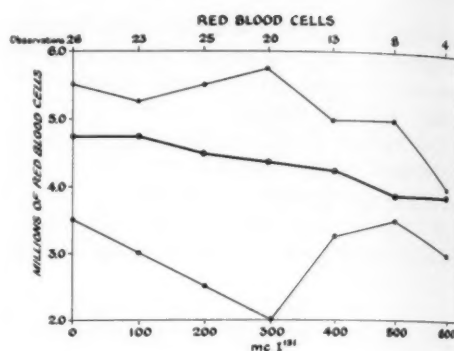


Fig. 10. Average, maximum, and minimum values for red cell counts for 36 patients who received total doses of more than 50 millicuries of  $I^{131}$ .

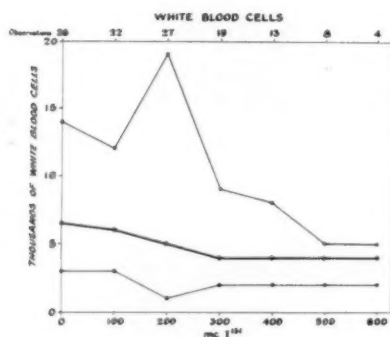


Fig. 11. Average, maximum, and minimum values for white cell counts for 36 patients who received total doses of more than 50 millicuries of  $I^{131}$ .

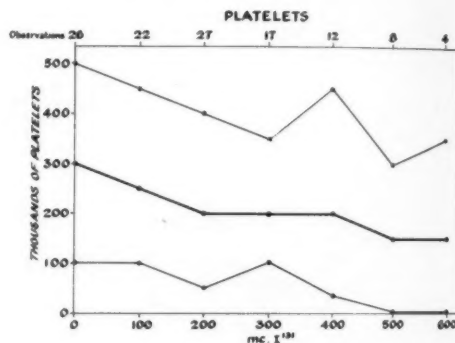


Fig. 12. Average, maximum, and minimum values for platelet counts in 36 patients who received total doses of more than 50 millicuries of  $I^{131}$ .

count before therapy was 6,500, decreased to 4,000 at 300 millicuries, and then remained essentially constant in the range 300 to 600 millicuries. The average platelet count steadily decreased from 300,000 at the beginning of therapy to slightly less than 150,000 after 600 millicuries of  $I^{131}$ .

The summarized data (Figs 9 to 12) fail to portray the wide range of individual response. In some patients a relatively large dose produced minimal effects, whereas in others roughly comparable doses resulted in more marked changes in the peripheral blood. Figures 13 and 14 illustrate the variation in individual response. In *Case XIII* (Fig. 13) a total of about 600 millicuries of  $I^{131}$  was given in a period of about nine months; 500 of the 600 millicuries were given in five and a

half months. The platelet count never dropped below 160,000, the hemoglobin concentration remained above 9.0, and the white cell count above 4,000. The lowest red cell count was 3.9. In *Case IX* (Fig. 14) the dose was approximately 565 millicuries of  $I^{131}$  in about six and a quarter months. In spite of transfusion, the platelet count dropped to 10,000, the hemoglobin concentration to 4.8, the white cell count to 1,850, and the red count to 1.4.

In 19 patients given treatment doses of  $I^{131}$  (average total dose, 409 millicuries), the maximum depression of the peripheral blood elements occurred at an average of two and a half months after the final treatment dose. In 17 of her patients given an average total dose of 111 millicuries of



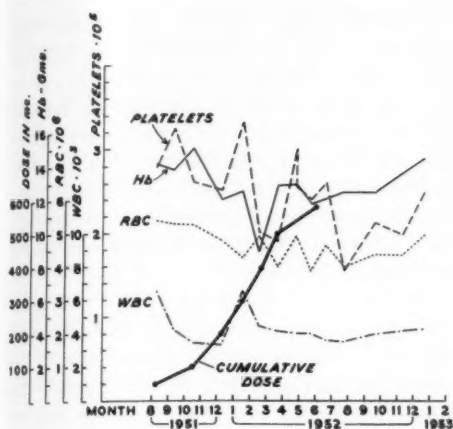


Fig. 13. Changes in hemoglobin level, platelet, red cell, and white cell counts of the peripheral blood associated with the administration of a total of 594 millicuries of  $I^{131}$ . Case XIII.

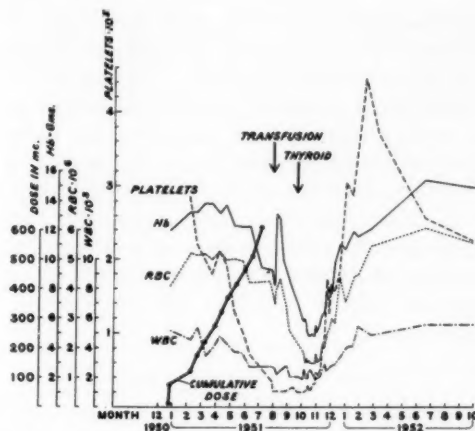


Fig. 14. Changes in hemoglobin level, platelet, red cell, and white cell counts of the peripheral blood associated with the administration of a total of approximately 555 millicuries of  $I^{131}$ . Case IX.

$I^{131}$  for completion of thyroidectomy, the maximum depression of the peripheral blood was observed at an average of three and three-tenths months after the final dose. After these patients were given thyroid extract at the conclusion of  $I^{131}$  therapy, the blood counts returned to approximately pre-treatment levels within a few months.

Aggeler, who studied 95 bone marrow specimens from 31 patients (1951 to 1953) under this radioiodine program (2), attempted to correlate the abnormalities found in the bone marrow with abnormalities of the peripheral blood and with the radioiodine dose. He found that, in general, the greatest bone marrow abnormalities occurred in those patients who received the largest doses of  $I^{131}$ . Of the patients who received less than 100 millicuries of  $I^{131}$ , only about a third demonstrated significant alterations in the bone marrow differential count, while two-thirds of those who received over 100 millicuries showed significant changes. As with the peripheral blood changes, however, there were many patients in whom the marrow changes did not correlate with the radioiodine dosage. Two types of abnormal bone marrow pictures were observed. The first was essentially a hypo-

cellular marrow exhibiting a decrease of all normal marrow elements. This was not the common picture and was attributed to technical error. The second and predominant type of marrow change was a marked increase in the proportion of erythropoietic elements present, accompanied by a decrease in the proportion of both immature and mature myeloid cells, with a normally cellular or slightly hypocellular marrow. The latter type of marrow change correlated fairly well both with the radioiodine dosage and with the degree of abnormality in the peripheral blood. This type of change was thought to result from an intense effort at regeneration by the erythropoietic series of cells, associated with some degree of maturation arrest.

Axelrod and Berman (3), in a study of bone marrow in hyperthyroidism and hypothyroidism, found that characteristically in hypothyroidism the active marrow is hypoplastic, the myeloid-erythroid ratio is usually normal, the hypoplasia affects all myeloid systems about equally, and the megakaryocyte content is usually lowered, but the latter is not reflected in the peripheral platelet count. A macrocytic, hypochromic anemia is the typical anemia of hypothyroidism. In the present study,

the patients did not show this type of marrow picture and the anemia was not of the hypochromic type. Therefore, it seems most probable that the effects on the hematopoietic system observed in these patients were predominantly the results of irradiation rather than of hypothyroidism. In support of this conclusion is the fact that 5 of the patients showed a substantial degree of return toward a normal blood picture before thyroid extract was administered.

#### SUMMARY AND CONCLUSIONS

1. This paper presents the experience at the University of California Hospital with the use of radioiodine in the treatment of cancer of the thyroid. Primarily, it considers 86 patients seen in the ten-year period from 1945 to 1954. An additional 31 postoperative patients with carcinoma of the thyroid are not included because there was no known residual cancer; 7 more were terminal or refused therapy. Of the 86 patients studied, 23 showed  $I^{131}$  affinity and 11 showed objective evidence of tumor arrest or regression. Four symptomatic patients received relief from their symptoms. Many patients were subjected to prolonged periods of myxedema to accomplish these results.

2. Ninety-five patients were female; 29, male. The age-incidence curve is quite flat, with 14 patients under seventeen and a half and 23 under twenty-two and a half years.

3. During the first five years of the program little attempt was made to influence iodine metabolism by the thyroid cancer. However, during the remainder of the time considerable effort was so expended; prolonged myxedema, TSH, and thiouracil derivatives were tried. During the initial phase, there was detectable radioiodine uptake in the tumors of only 4 of 51 patients studied; during the second period, in 19 of 35.

4. The 23 patients with known residual or recurrent thyroid cancer which metabolized detectable amounts of radioiodine were treated with  $I^{131}$ . In general, the

treatment plan was to administer 100 millicuries of  $I^{131}$  per month as long as there was evidence of cancer uptake of  $I^{131}$  or until marked hematopoietic depression appeared. In 5 of the 23 patients the course of therapy was not completed, either because of death or because they became too ill to come in for treatment. Seven others showed no evidence of tumor regression or arrest.

5. In 11 of the 18 patients who completed the projected course of radioiodine therapy, there was evidence either of arrest or of regression of the tumor. By Dec. 31, 1954, 7 of these 11 had had regrowth of cancer tissue and died; 1 had a tumorous mass which had shown no signs of growth in two and a half years; 3 were well, with no evidence of residual cancer. Because of the natural history of carcinoma of the thyroid, it is not possible to evaluate the effect of radioiodine therapy on survival time in the patients treated.

6. Complete destruction of thyroid function was usually required before iodine metabolism by the thyroid carcinoma could be demonstrated. Occasionally such agents as TSH and thiouracil derivatives appeared to increase radioiodine uptake. In 2 of these cases there was strong evidence that uptake did not occur before removal of the thyroid but that it did occur within twelve and sixteen days, respectively, after radical thyroidectomy. In these 2 cases, seven or eight separate cancer-containing lymph nodes were available for study.

7. Several tests of hepatic and renal function were performed in 22 patients: 21 received a total dose of 100 to 650 millicuries of  $I^{131}$ ; 1 received a total of 1,000 millicuries. Although some abnormal values for these tests were found sporadically, no correlation existed between the size of the radioiodine dose and either the incidence of abnormal values or the degree of abnormality. Most of these patients were myxedematous throughout the course of therapy, and it is thought that the disturbances of hepatic and renal function were probably secondary to the myxedema. In patients surviving their cancer, ab-

normal values were not found after a return to euthyroid status.

8. Studies of the peripheral blood were carried out in 36 patients who received between 50 and 600 millicuries of  $I^{131}$ . While the response varied widely, the average values for hemoglobin and red cell, white cell, and platelet counts gradually decreased with increasing radioiodine dose. Ninety-five bone marrow specimens from 31 patients were studied. The degree of bone marrow change tended to parallel the amount of  $I^{131}$  administered. The predominant marrow change was an increase in the proportion of erythropoietic elements and a decrease in the proportion of both immature and mature myeloid cells with a normally cellular or slightly hypocellular marrow. It is thought that the hematopoietic changes were attributable to the irradiation with  $I^{131}$  rather than to hypothyroidism.

9. Until better results can be obtained with radioiodine therapy, it will be useful in a relatively small percentage of cases. Surgery and external irradiation remain the treatments of choice whenever the disease can be attacked effectively by these means.

#### ADDENDUM

As of Jan. 1, 1957, 1 additional death had occurred in the patients treated with  $I^{131}$  (Case XVII). The status of the other patients was unchanged.

#### APPENDIX: SELECTED CASE HISTORIES<sup>4</sup>

CASE II: This patient came to medical attention in 1932, at the age of eight, because of a mass in the neck and dysphagia. Between January and June 1932 he was treated with roentgen rays, 2,200 r (air) to the anterior neck (120 kvp, 0.25 mm. Cu + 1 mm. Al added filtration;  $11 \times 11$ -cm. field). In June 1932, a subtotal thyroidectomy was performed; the histologic diagnosis was hyperplasia and papillary adenocarcinoma of the thyroid. Roentgen

<sup>4</sup> In the case histories, the number of millicuries of  $I^{131}$  given as treatment dosage does not include the test doses. Nor does it include  $I^{131}$  given to destroy the thyroid if this was administered prior to a course of  $I^{131}$  treatment by several months. If, however, thyroid destruction immediately preceded treatment, the thyroidectomizing doses were considered part of the treatment and are included in the total therapeutic dosage.

examination of the chest showed multiple bilateral pulmonary densities. The patient remained asymptomatic and without palpable tumor or change in the pulmonary metastases until February 1944, when a mass developed in the pharynx. This was treated with roentgen rays: 1944, 1,200 r (tumor) in nine days ( $7 \times 7$  cm.-field) through the region of the left jaw, directed toward the pharyngeal mass; July 1945, 700 r (tumor) in ten days *via* an intraoral cone. The pharyngeal mass decreased in size. A left cervical mass which appeared in 1946 was given 2,000 r (tumor dose) in eleven days (200 kvp, 1.05 mm. Cu h.v.l., and 0.5 mm. Cu + 1 mm. Al added filtration).

The patient was seen for the first time in the Radioiodine Laboratory in January 1947, at the age of twenty-three years. At this time he was euthyroid and appeared well. There was evidence of  $I^{131}$  uptake in the region of the thyroid and of the most numerous pulmonary lesions. During January a total of 17 millicuries of  $I^{131}$  were given in an unsuccessful attempt to destroy thyroid function. In June, 94 millicuries of  $I^{131}$  were administered in a second attempt, but again the patient remained euthyroid. In September 1948, a palpable cervical node developed, the biopsy specimen from which was diagnosed histologically as carcinoma metastatic from the thyroid. In September 1949, a King operation on the vocal cords was performed for a high airway obstruction due to paralysis of the cords. Histologic examination showed carcinoma in the pharynx.

There was uptake of  $I^{131}$  in the neck and chest, and a course of  $I^{131}$  therapy was initiated with a dose of 150 millicuries. Two additional doses of 100 millicuries each were given at monthly intervals. By the end of November 1949, urinary excretion of the administered  $I^{131}$  had increased to 100 per cent and treatment was stopped. Two months later the patient was myxedematous. The pulmonary and pharyngeal lesions disappeared after this course of treatment (Fig. 2). The maximum depression of blood counts occurred about five months after the last dose of  $I^{131}$ : hemoglobin, 10.6; red cells, 3.8; white cells, 3,500; platelets, 130,000. These values slowly returned to normal during the following few months and remained within the normal range until a leukocytosis developed about four weeks prior to death. In November 1950 the pharyngeal mass recurred but, since no  $I^{131}$  uptake could be detected, it was treated with roentgen rays, with some decrease in size. Pulmonary metastases reappeared and a right supraclavicular mass developed in May 1952, at which time thyroid extract was discontinued. By September there was definite  $I^{131}$  uptake in the supraclavicular mass and the patient was treated with 98 millicuries of  $I^{131}$ . At that time he had become myxedematous and was miserable. One month later, at twenty-eight years of age, he died following massive and extremely rapid pulmonary invasion by anaplastic tumor.

*Comment:* This patient received palliation from  $I^{131}$  therapy, since both pulmonary and pharyngeal masses disappeared grossly after therapy. The carcinoma ultimately became widespread, and death occurred before the effects of additional treatment with  $I^{131}$  could be evaluated. Had a more radical course of  $I^{131}$  therapy been given in 1947, when the tumor uptake was high, a better result may have been achieved. It is noteworthy that this patient lived an active life for twenty years with widespread metastases.

**CASE III:** The history of this white female patient began in 1938 at forty-eight years of age, when swelling of the left side of the neck occurred. Surgical exploration of the mass in 1940 revealed an inoperable tumor extending below the left clavicle and surrounding the subclavian vein and artery, diagnosed histologically as papillary adenocarcinoma of the thyroid metastatic to the supraclavicular region. The patient was given roentgen therapy. The mass regressed and remained small until November 1949, when it began to grow again.

When the patient was first seen in the Radiiodine Laboratory in March 1950, at sixty years of age, she was euthyroid and asymptomatic except for the presence of a hard tumor in the left supraclavicular fossa, at the site of the previous roentgen therapy, and a lemon-sized mass protruding from the anterior chest wall over the manubrium (Fig. 3). No other metastases were discovered. Geiger counter studies and radioautographs following a test dose of 1 millicurie revealed no  $I^{131}$  in biopsy specimens, and no  $I^{131}$  treatment was given.

The patient returned in February 1952, still euthyroid and, except for the mass, asymptomatic. There was normal uptake of a test dose in the thyroid region and questionable evidence of uptake in the neck tumor, but no evidence of uptake in the anterior chest wall tumor. In order to destroy the normal thyroid, 23 millicuries of  $I^{131}$  were administered. Studies one month later showed that the patient was still euthyroid, but only 4 per cent of the  $I^{131}$  was concentrated in the region of the thyroid. At this time the mass in the chest wall had ulcerated and had started to bleed profusely. Several transfusions were given. Since there was evidence of a small amount of uptake in the chest wall tumor, definitive treatment with  $I^{131}$  was attempted.

In April 1952, the patient was given 92 millicuries of  $I^{131}$  and within one month became markedly hypothyroid. Between April 4 and July 28, 1952, a total of 492 millicuries were given. By mid-September, the hemoglobin level had dropped from 13.2 to 9.5, the red cell count from 5.2 to 3.6, the white cell count from 4,830 to 1,850, and the platelet count from 253,000 to 157,000. Definite necrosis

of the tumor occurred during the course of treatment. At this time the uptake in the region of the tumor was about 1 per cent of the administered dose. This was not increased by a course of TSH.

After treatment with  $I^{131}$  had been discontinued in July, sufficient thyroid extract was administered to return the patient to the euthyroid state. The subcutaneous chest wall tumor decreased in size (Fig. 3), stopped bleeding, and nearly healed over. By the early part of 1953 the patient felt well and returned to rather heavy work in a laundry.

In June 1953, the tumor began to bleed again and to grow rapidly. Left occipital and neck pain developed. A pathologic fracture of the left humerus occurred in March 1954. The patient's condition rapidly grew worse and she died in April, 1954.

*Comment.* Necrosis of the tumor and cessation of bleeding were associated with  $I^{131}$  treatment. Some degree of palliation thus occurred—whether because of  $I^{131}$  therapy or some spontaneous change cannot be ascertained. In this case, quite marked blood changes became evident rather early in the course of treatment, with decrease of all cellular elements. This patient required more than 25 millicuries of  $I^{131}$  before myxedema developed.

**CASE IX:** A 68-year-old female was referred to the Radiiodine Laboratory in December 1950, with an inoperable carcinomatous mass in the neck estimated to weigh about 600 gm. She was euthyroid and, except for respiratory stridor, asymptomatic. Histologic examination of a biopsy specimen obtained at another hospital had shown alveolar adenocarcinoma of the thyroid. There was no evidence of metastases. Scanning with a collimated scintillation counter after a 10-millicurie test dose of  $I^{131}$  showed definite uptake in the neck tumor. A 63-millicurie thyroidectomizing dose of  $I^{131}$  was given in December 1950. The patient remained clinically euthyroid.

$I^{131}$  therapy was started with an initial dose of 89 millicuries in February 1951. Within the next month the tumor became smaller and firmer, and by late March definite hypothyroidism had appeared. Therapy was continued with doses of 91, 85, 88, 39, and 99 millicuries (March through July 6, 1951). In August, purpuric spots appeared in the skin. Profound changes were observed in the blood picture (Fig. 14). The lowest levels, October 1951, were: hemoglobin, 4.8; red cells, 1.4; white cells, 1,850; platelets, 10,000. These changes occurred despite three transfusions of whole blood (500 cubic centimeters) in August and September 1951. Treatment with thyroid extract was started in September. Improvement in the blood picture was evident by



early November, and by May 1952 all the peripheral blood values were in the normal range.

By June 1952, the tumor had decreased to approximately one-third its initial size. When the patient was last seen, in September 1954, she felt well. There was no evidence of regrowth of the tumor (Fig. 4) or of metastases.

*Comment:* A carcinomatous mass in the neck decreased markedly in size after a total of 554 millicuries of  $I^{131}$  had been administered. No regrowth was evident 3 years after therapy. The therapy produced profound but transient changes in the peripheral blood.

CASE XIII: About five years prior to study in the Radioiodine Laboratory, a 60-year-old white female had had a subtotal thyroidectomy (November 1946). Thyroid carcinoma was found involving the trachea, regional vessels, and lymph nodes. Tumor removal was known to be incomplete and roentgen therapy was given. In October 1949, a roentgenogram of the chest showed bilateral pulmonary metastases. Six months later there was pain in the right chest which was relieved by roentgen therapy (2,000 r in air). In June 1951, chest films showed a destructive lesion of the right 10th rib; this also was treated with roentgen rays (2,700 r, air).

In August 1951, examination in the Radioiodine Laboratory revealed tumors at the base of the neck, in the lungs, and in the right 10th rib. Examination of the histologic sections obtained at the time of surgery in 1946 established a diagnosis of papillary adenocarcinoma of the thyroid. Definite  $I^{131}$  uptake in the rib lesion and normal uptake in the thyroid area were demonstrated. A dose of 49 millicuries was given to produce thyroid ablation. By October there was evidence of  $I^{131}$  uptake in the right lung field as well as in the rib lesion. The patient still was not definitely hypothyroid, and an additional 53 millicuries of  $I^{131}$  were given. When seen again in December, she was definitely myxedematous and, because of persistent although slight localization of  $I^{131}$  in the right lung and the right 10th rib, treatment with  $I^{131}$  was begun. Doses of approximately 100 millicuries were given in December 1951 and in January, February, March, and May 1952. During this period the 48-hour urinary excretion of  $I^{131}$  ranged between 82 and 92 per cent of the administered dose. By May there was no longer any evidence of tumor localization of  $I^{131}$ , and the treatment was discontinued. Thyroid extract was started and the patient returned to a euthyroid status.

In May 1953, a right hilar enlargement was discovered by roentgenographic examination. Thyroid extract was discontinued and a course of TSH was given intravenously, but this failed to stimulate any demonstrable localization of  $I^{131}$  in the tumor. By

July the 48-hour urinary excretion of  $I^{131}$  had dropped to 71 per cent, and a 100 millicurie dose of  $I^{131}$  was administered. The patient's condition, however, became progressively worse. Recurrent pleural effusion was treated with 30 millicuries of radioactive gold introduced into the right pleural space. Multiple bony metastases developed, and death occurred in December 1953.

*Comment:* The tumor known to be present in this patient remained quiescent for about one year after the administration of a course of  $I^{131}$  therapy. At the end of this time, however, additional widespread metastases appeared, with death shortly thereafter. Approximately 700 millicuries of  $I^{131}$  were administered without any discernible effect on the peripheral blood, even though 500 millicuries were given within five and a half months (Fig. 13).

CASE XVII: This 71-year-old white female was referred to the Radioiodine Laboratory in May 1952 for treatment of an inoperable thyroid carcinoma. She had first noticed a mass in the right neck in January of that year. Three months later, histologic examination of a biopsy specimen from a left cervical node revealed well differentiated adenocarcinoma metastatic from the thyroid. Invasion of the right jugular vein by a large tumor was found at surgery.

In May 1952 the patient was asymptomatic and euthyroid. Uptake of  $I^{131}$  in the thyroid area was within normal limits. Studies with a collimated scintillation counter indicated definite uptake in the main mass in the right neck but no evidence of other tumors. In June, 25 millicuries of  $I^{131}$  were given in an attempt to destroy thyroid function and thus enhance tumor avidity for  $I^{131}$ . Studies one month later demonstrated continued uptake by the thyroid and an additional dose of  $I^{131}$  was given. By September frank hypothyroidism was present. At this time there was uptake of 20 per cent of a 2-millicurie test dose in the tumor in the right neck.

A treatment dose of  $I^{131}$ , 100 millicuries, was then given. By October 1952 the mass in the neck was definitely smaller. Since at this time only 1 per cent of a test dose was taken up in the tumor and 88 per cent was excreted in the urine, TSH was given intravenously, 10 units daily for eighteen days. During these eighteen days the 48-hour urinary excretion of  $I^{131}$  dropped from 88 to 36 per cent, and uptake in the mass in the neck increased from 1 to 17 per cent. Another treatment dose of 101 millicuries of  $I^{131}$  was given. In January 1953, uptake in the neck tumor had dropped to 3 per cent. This increased to 6 per cent following a further course of TSH (10 units daily for three days), and



99 millicuries of  $I^{131}$  were given. Thereafter, uptake in the neck tumor was maintained without further TSH, and  $I^{131}$  therapy was continued from March through July 1953, with doses of 95, 98, 105, 105, and 100 millicuries at monthly intervals. In July the patient was only slightly hypothyroid clinically; the basal metabolism rate was -13 per cent; the serum protein-bound iodine level was 6.1 micrograms per cent. This return to a nearly euthyroid status was assumed to be due to the production of thyroxin by the neoplasm. A gradual decrease in the size of the tumor occurred between July 1952 and July 1953 (Fig. 5).

Prior to treatment the blood counts were within normal limits. The maximum depression of the peripheral blood occurred in November 1953: hemoglobin, 5.8; red cells, 1.4; white cells, 2,900; platelets, 44,000. It was planned that  $I^{131}$  therapy would be resumed when these blood levels returned to normal. The counts did show a slow but progressive increase without the use of blood transfusions or of thyroid extract. When the last studies were made, in January 1955, the values were as follows: hemoglobin, 13.2; red cells, 4.4; white cells, 6,100; platelets, 233,000. The neck tumor continued to decrease in size and, in January 1955, was barely palpable; hence further therapy was not given. The patient was asymptomatic, was doing her own housework, and was engaging in other usual activities.

*Comment.* There was a definite decrease in the size of the thyroid carcinoma mass in the neck after treatment with  $I^{131}$ .

#### SUMMARY IN INTERLINGUA

##### Studios con Radioiodo

#### VI. Evaluation del Uso de Radioiodo in le Tractamento de Carcinoma Thyroide, Basate Super le Experimentias Facite al Universitate California Inter 1938 e 1954

Iste articulo presenta le experientias facite al Hospital del Universitate California in le uso de radioiodo ( $I^{131}$ ) como agente therapeutic in caso de cancro thyroide. Le articulo concerne primariamente 86 patientes vidite durante le decennio ab 1945 usque a 1954. In 23 de iste patientes, le tumor exhibiva signos de affinitate pro radioiodo, e ergo therapia a  $I^{131}$  esseva instituite. In general, le plano therapeutic provideva 100 mc de  $I^{131}$  per mense durante que acceptation del agente per le tumor esseva constatabile o usque serie grados de depression hematopoietic superveniva.

In 5 patientes le tractamento non poteva

A marked but transient depression of the formed elements of the peripheral blood occurred after a total dose of almost 1,000 millicuries of  $I^{131}$ . It is thought that this patient had little or no non-neoplastic thyroid tissue when last seen and that her residual tumor was functioning sufficiently to maintain a euthyroid status.

**ACKNOWLEDGMENT:** The authors are grateful for the guidance and assistance of Dr. Robert S. Stone, Chairman of the Department of Radiology.

Physicians who participated in or contributed to the program at various times are Drs. Paul M. Aggeler, George L. Alexander, Morris E. Dailey, Nadine Foreman, A. V. Holmes, Richard H. Kirkland, Stuart Lindsay, and Harry S. Ogden.

The studies were carried out with the technical assistance of Marian I. Feigenbaum, James M. Felts, Nancy V. Louw, Enid A. Moor, Louise Prestige, A. D. Prestridge, and Ann B. Raitt.

Department of Radiology  
University of California Medical Center  
San Francisco 22, Calif.

#### REFERENCES

1. MILLER, E. R., AND SCOFIELD, N. E.: Studies with Radioiodine. IV. Collimating Cones for Crystal Counters. *Radiology* 65: 96-107, July 1955.
2. AGGELER, P. M.: The Effect of  $I^{131}$  on the Bone Marrow. Atomic Energy Commission Report UCSF-8, January 1954, pp. 38-57.
3. AXELROD, A. R., AND BERMAN, L.: The Bone Marrow in Hyperthyroidism and Hypothyroidism. *Blood* 6: 436-453, May 1951.

esser completate. In 7 nulle regression e nulle arresto del tumor esseva evidente. In 11 le tumor regrededa o dispareva. Le 31 de decembre 1954 il esseva a constatar que 7 del 11 habeva habite recrescentias de histos cancerose e esseva morte; 1 viveva con tumor in stato arrestate de post duo annos e medie; 3 se trovava ben e monstrava nulle signos de cancro residue.

Super le base del these que myxedema provide un stimulo pathologic pro le function tumoric, ablation total del glandula thyroide esseva effectuate con le objectivo de augmentar le aviditate del histos neoplastic pro  $I^{131}$ . Multes del

patients deveniva myxedematose durante prolongate periodos de tempore. Cursos de thiouracil o propylthiouracil o de hormon thyroïdo-stimulatori esseva institute in certe casos e pareva a vices intensificar le acceptation de  $I^{131}$ .

Tests de function hepatic e renal durante le tractamento revelava certe anormalitates, sed il esseva concludite que istos esseva secundari al myxedema plus tosto que effectos directe del radioiodo. Le responsa del sanguine peripheric variava grandemente, sed le valores medie pro hemoglobina e le numerationes erythro-

cytic, leucocytic, e plachettal descendeva gradualmente con ascenditas del doses de radioiodo. Le grado del alteration in le medulla ossee etiam tendeva a tener se parallel al quantitate de  $I^{131}$  administrate.

Usque melior resultados pote esser obtenite per medio de therapia a radioiodo, le autores crede que iste therapia va esser utile in un relativamente basse procentage de casos de carcinoma thyroïde. Chirurgia e irradiation externe remane le tractamento de election quando le morbo pote esser attaccate efficacemente per medio de illos.



## The Posterior Condylar Fossa, Foramen and Canal, and the Jugular Foramen<sup>1</sup>

LEWIS L. HAAS, M.D.<sup>2</sup>

VARIATIONS OF the posterior condylar fossa and jugular foramen are not adequately known in roentgen practice and are frequently the source of diagnostic difficulties and misinterpretations. Misinterpretation of posterior condylar fossa variations has occasionally even led to surgical intervention for a presumed jugular glomus tumor. It seems desirable, therefore, to analyze the roentgen anatomy of these structures.

The *condylar fossae* are situated at either side of the foramen magnum behind the occipital condyles (Fig. 1, A) and accommodate the superior posterior part of the lateral mass of the atlas when the head is bent backward (see Cunningham or other anatomical text). The posterior condylar canal opens through a foramen into the fossa (Fig. 1, B), transmitting an emissary vein from the suboccipital venous plexus to the sigmoid sinus, or at times to the jugular bulb. Fossa, canal, and foramen are all inconstant formations.

The fossa is best visualized radiologically on the occipital oblique and postero-anterior nuchofrontal views, showing the posterior half of the foramen magnum. The fossa is visible close to the posterior circumference of the foramen magnum, behind the condyles (Figs. 1-4). The jugular foramen is located more laterally and anteriorly (Fig. 1, A). The roentgen appearances of the posterior condylar fossa—its size, shape and margins—are extremely variable. It is frequently entirely absent (Fig. 3, D); it may be very shallow, with no clear-cut margin, in which event it will not be clearly visualized. It ranges in size from very small to very large. As demonstrated radiologically, the size depends also upon the beam direction; the roentgen enlargement is greater on pos-

tero-anterior than on anteroposterior views. The shape can be regular—round or oval—or entirely irregular (Fig. 3, C). At times only segments of the outline are visualized. Asymmetry is frequent. The fossa may be large; it may be sharply outlined; it may be present only unilaterally (Fig. 2, A). These asymmetries and variations have no clinical significance.

A frequent misnomer is the designation of the translucent shadow of the fossa as a foramen. If the indentation is deep, the floor of the fossa may be very thin and radiographically translucent; its margin may form a sharp rim, thus giving the false radiological impression of a foramen and foraminal margin. The term, "foramen," is reserved here for the small opening of the vascular canal into the fossa and is not applied to the occasional sharp rim of the fossa itself (Fig. 2, B).

The base of the fossa is not always of uniform thickness, and irregular densities occasionally result within the more translucent fossa shadow (Fig. 3, A). Small ridges also may occur within the fossa.

Similar non-homogeneity may be caused by the posterior condylar canal, which usually leads obliquely into the fossa through a relatively small foramen. Foramen and canal are not always clearly visualized, even if present, but they may produce the non-homogeneous appearance mentioned above or appear as arc formations within the shadow of the fossa (Fig. 3, A and B). Above-average film technics may visualize more clearly the parallel walls of the canal or the ring shadow of the foramen. These structures are better demonstrated when the fossa is absent but the canal is present (Fig. 3, D).

There is no special pathological condition in which the posterior condylar fossa

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<sup>2</sup> Died in June 1957.

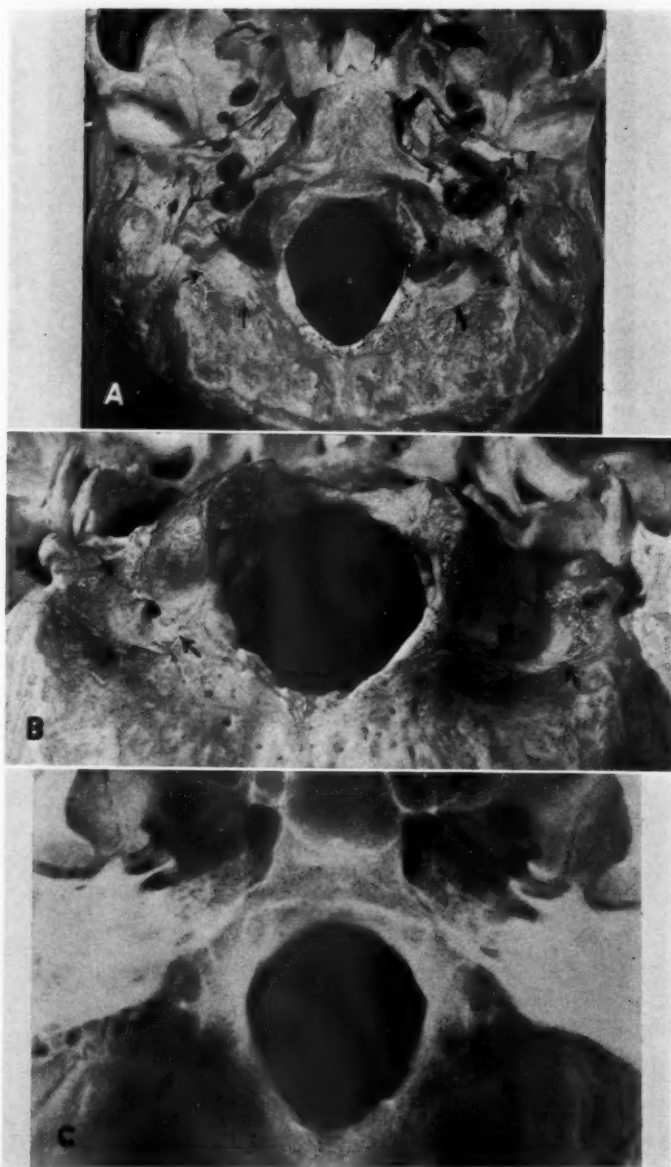


Fig. 1. A. Foramen magnum area, lower surface. The posterior condylar fossae are marked by arrows behind the occipital condyles, without sharp margins. The posterior condylar foramina are hidden by the condyles. The jugular foramina are situated anteriorly and more laterally.  
 B. Tangential view showing the posterior condylar foramina at the bottom of the fossa, close to the posterior condylar margins.  
 C. Roentgenogram showing the thin, radiotranslucent floor of the fossa with blurred outline. Foramen and canal are not clearly visualized.

has been the direct subject of clinical roentgen examination. Advanced lesions of the jugular fossa region may, however,

extend to this area. For example, in the case of a glomus tumor (Fig. 4), the surgical defect extended from the jugular area

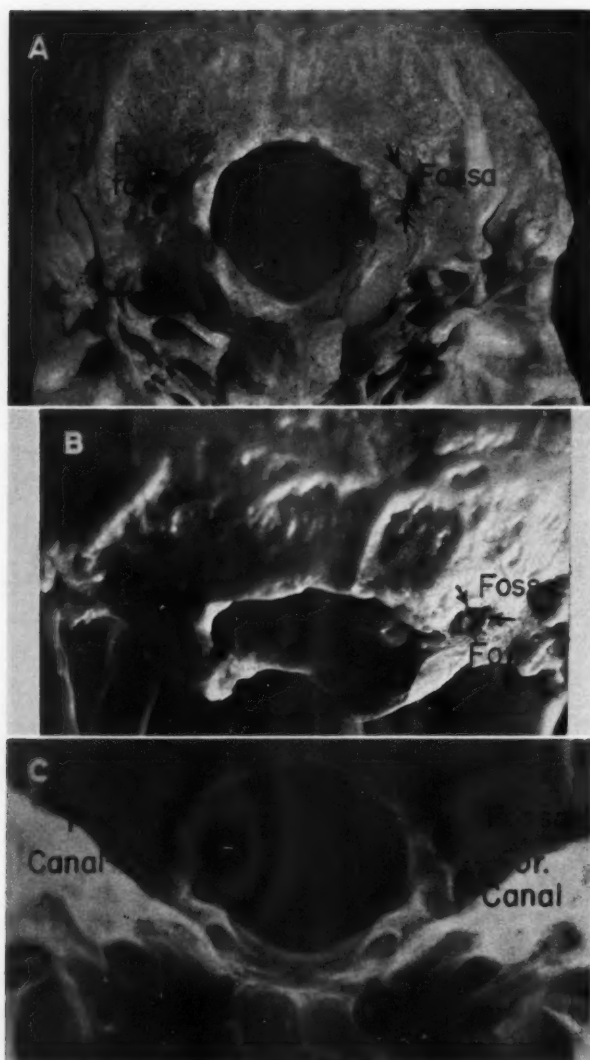


Fig. 2. A. Small posterior condylar fossa with sharp margin, on the left. On the right the fossa is not formed; only the foramen is present. Accessory small emissary foramina in the vicinity.

B. Tangential view showing the sharp rim of the left posterior condylar fossa, and at the bottom of the ampullar fossa the smaller foramen of the posterior condylar canal.

C. Roentgenogram showing the circular sharp rim of the left fossa; at its bottom the cross section of the foramen, outlined by an annular density, opens into the visible canal-shadow. On the right side, the foramen and canal are visualized; the fossa is not seen.

to the condylar fossa. It is possible that a better understanding of the roentgen anatomy of this structure may be useful in the diagnosis of pathologic processes and anomalies, particularly of finer orthopedic

alterations of the atlanto-occipital area.

The roentgen examination of the *jugular foramen* is a long recognized procedure, particularly in the "jugular foramen syndrome" (symptoms of involvement of



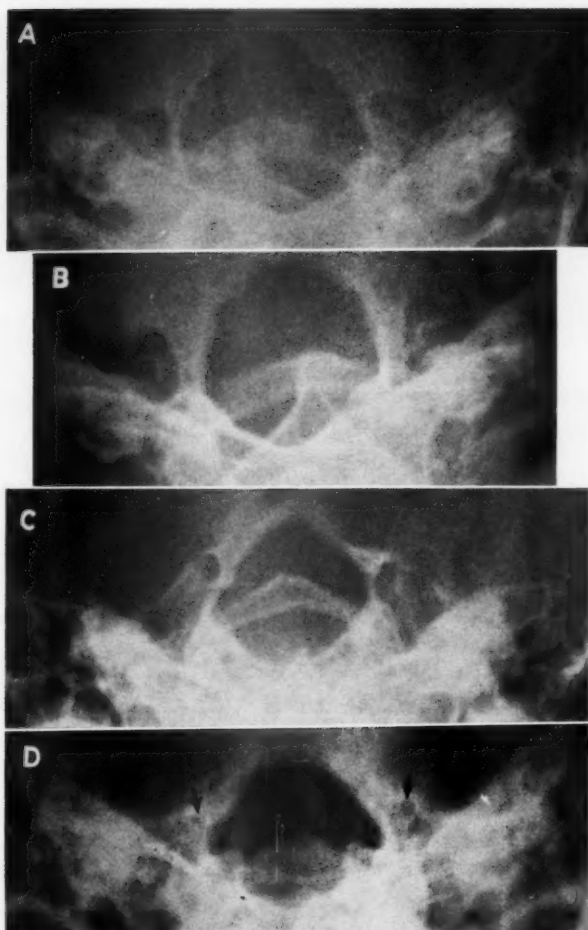


Fig. 3. Variations. A. Normal posterior condylar fossae with sharp margins. Uneven density of the floor of the left fossa.

B. Large normal posterior condylar fossae, with circular shadow of the foramina in their center.

C. Large irregular fossae, with indistinct visualization of the canals. Variation without clinical significance.

D. Posterior condylar fossae are absent. Small foramina are visualized.

the ninth to eleventh cranial nerves) and in jugular glomus tumors. A good visualization will be obtained on incomplete axial views, similar to highly exaggerated semiaxial views of the paranasal sinuses (Figs. 5 and 6). The central beam passes across the mandibular symphysis and the sphenoid area (anterior portion of sphenoid sinus), or the reverse, and could therefore be said to follow a verticomental, or mentovertical

direction (instead of the verticosubmental or submentovertical direction of the axial views). Following the lateral margin of the basiocciput, or the adjacent petro-occipital fissure in the posterolateral direction, one reaches the jugular foramen in the projection of the posterior middle portion of the petrous bone.

Posteriorly the lateral mass of the atlas is situated close to the fossa. The mentovertical projection shows the charac-

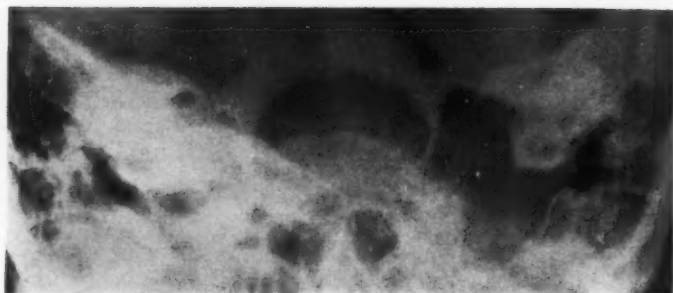


Fig. 4. Large surgical defect in a case of jugular glomus tumor, including the jugular foramen, petrous apex, and posterior condylar fossa area.

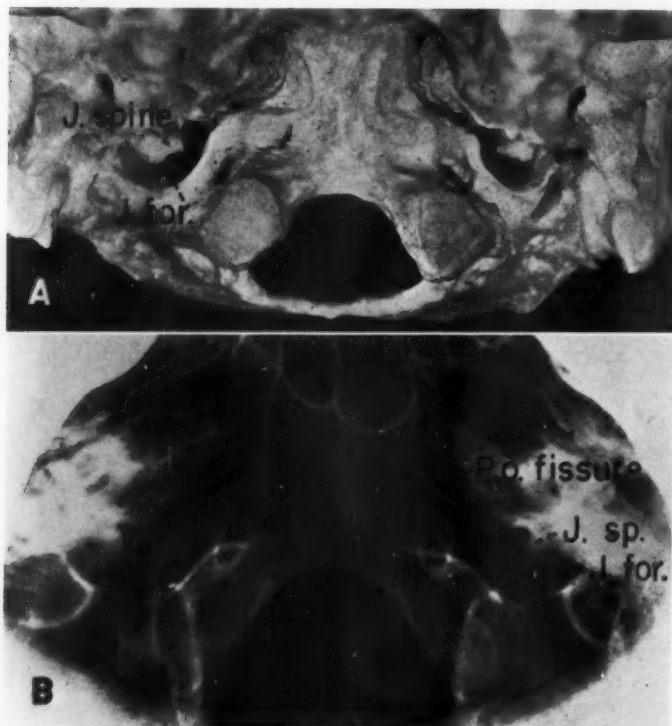


Fig. 5. A. Jugular foramina in the mentovertical position of the skull.  
B. Roentgenogram taken in the same position, showing petro-occipital fissure and jugular spine.

teristic configuration of the fossa as seen on the basal external surface of the dried skull, with its oval convex posterior outline (Fig. 5). Its anterior outline, formed by the petrous bone, is less sharp, and it is interrupted in the middle by the protrusion of the jugular spine of the petrous bone (Fig. 7). Variations and asymmetries

in size, shape, and sharpness of contours are frequent (Fig. 8) and demand caution in differentiation from disease processes. The contours of the atlas should not be mistaken for the jugular foramen outline. Occasionally correlation with clinical information is necessary for a definite diagnostic conclusion. Figure 9 shows the

pathological appearance of the jugular foramen due to extension of an infiltrating neck metastasis to the jugular area in a case of oropharyngeal carcinoma (surgically proved).

Several other views of the jugular foramen have been described. Particularly impressive is the visualization by lamina-gram in a position similar to the Stenvers' view (Fischgold, *et al.*).



Fig. 6. Mentovertical (= exaggerated semi-axial) view for visualization of the jugular foramen.

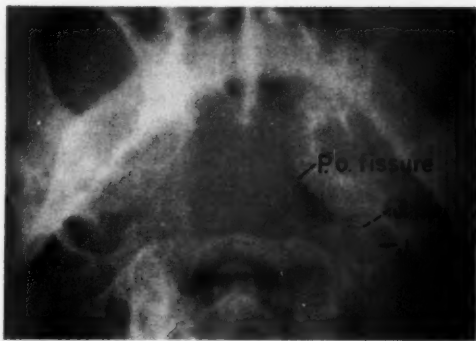


Fig. 7. Characteristic normal jugular foramina with jugular spine.

#### SUMMARY

The roentgen anatomy of the posterior condylar fossa, canal and foramen, and of the jugular foramen are described. Roentgen diagnostic misinterpretation is frequent in practice and should be avoided.

NOTE: Dr. Warren Q. Bradley, former resident, contributed to the initiation of this roentgen-anatomical study.

Department of Radiology  
University of Illinois, College of Medicine  
Chicago 12, Ill.

#### REFERENCES

- CUNNINGHAM, D. J.: Textbook of Anatomy. Edited by J. C. Brash and E. B. Jamieson. New York and London, Oxford University Press, 8th ed., 1943.  
FISCHGOLD, H., METZGER, J., AND KORACH, G.: Tomographie de la région pétro-sphéno-occipitale. Incidence des quatre dernières paires crâniennes. *Acta radiol.* 42: 56-64, July 1954.

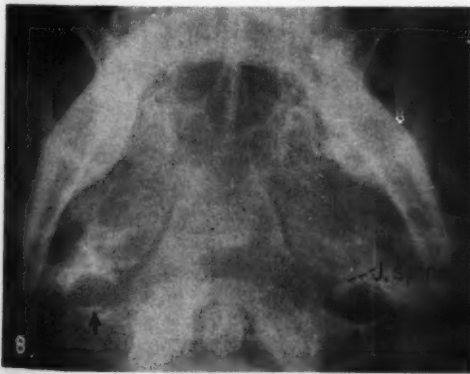


Fig. 8. Asymmetry of normal jugular foramina.

Fig. 9. Left: Normal jugular foramen on the left. On the right the outline of the jugular foramen is indistinct due to erosion by a cervical metastasis from oropharyngeal carcinoma (proved). The atlas outline should not be misinterpreted as the jugular foramen contour.

## SUMMARIO IN INTERLINGUA

**Fossa, Foramine, e Canal Condylar Posterior e Foramine Jugular**

Normal variationes in le fossas condylar posterior e in le foramines jugular pote resultar in difficultates diagnostic. Il occorre non infrequentemente que illos es misinterpretate roentgenologicamente como effecto de un processo pathologic. Un plus precise familiaritate con le anatomia roentgenologic de iste structuras pote prevenir tal errores.

Le fossa condylar posterior se visualisa le melio in le vista oblique occipital o postero-anterior. Illo es extremamente variabile in dimensiones, conformation, e

contorno. Illo pote esser completamente absente, e frequentemente illo es asymmetric. Variationes in le spissitate de su base pote resultar in un apparentia de non-homogeneitate in le roentgenogramma. Omne iste variationes es disproviste de signification clinic.

Le foramine jugular es ben demonstrabile in un vista axial incomplete. Etiam illo es capace de variationes e de asymmetricia in dimension, conformation, e delineation e require circumspection interpretative.



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# Surface and Entrance Dose for a 2-MVP X-Ray Beam<sup>1</sup>

NORMAN A. BAILY, Ph.D., and NORMAN S. BEYER, M.A.

WHEN A BEAM OF supervoltage x-rays is incident upon the surface of any material, because of the predominance of forward scattering, electronic equilibrium does not exist in the initial layers of the material. The introduction of even very small amounts of material between such a surface and the beam may change radically the degree to which electronic equilibrium is approached. In the case of 2-MVP x-rays, it will be shown that the number of forward scattered electrons existing in a small air volume changes so rapidly, as absorbing layers are added, that determination of such quantities

use of the Failla extrapolation chamber (1).

## EXPERIMENTAL

The data reported in this paper were obtained with a 2-MVP General Electric x-ray generator. This is a generator of the resonant transformer type having a tube with a transmission target. The beam was filtered with 1.0 mm. of lead, giving a half-value layer of 7.6 mm. of lead (2). The focal chamber distance used was 100 cm.

The extrapolation chamber designed for use in this experiment is shown in Figure 1. Its useful diameter is 40 cm.

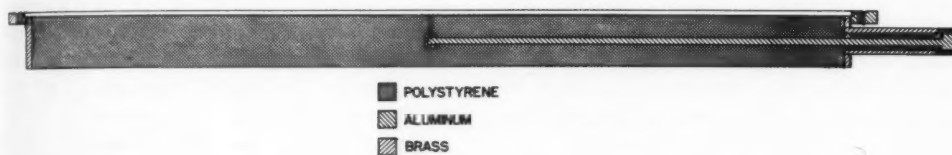


Fig. 1. Large-field extrapolation chamber.

as the surface dose and electron build-up characteristics cannot be determined by thimble-chamber measurements.

The implications of extremely low surface dosage for the radiation therapist must be carefully considered. First, a traditional clinical guide is lost, that is, the guidance provided by observation of the skin reaction. Second, although the surface dose is very low, a peak dosage value in excess of that in air is delivered to a layer of tissue below the skin. Third, the dose on the skin comprising the exit portal may very possibly exceed that delivered to the entrance port.

Experiment has shown that both the magnitude of the surface dose and the nature of the build-up curve in this region can be accurately determined through the

This large area allows measurements to be made for entrance portals ranging between 25 and 625 sq. cm. The surface of the polystyrene plate serving as one electrode is coated with a thin layer of colloidal graphite.<sup>2</sup> The collecting area is defined by producing a fine scratch with a razor blade used as a lathe tool. The diameter is then measured with an optical comparator. The upper electrode was constructed by coating sheets of either rubber hydrochloride or polyethylene with graphite. The average thickness of the thinnest film used was 1.143 mg./sq. cm., which includes the added thickness due to the graphite coating. These films were then tightly stretched between the hoop rings to prevent sagging. The ring was machined while mounted on the

<sup>1</sup> From the Department of Radiation Therapy, Roswell Park Memorial Institute, Buffalo, N. Y. Accepted for publication in May 1957.

<sup>2</sup> Dag dispersion #154.



chamber, thereby insuring parallelism of the two electrodes. The spacing is varied 1 mm. when the upper electrode is rotated one revolution.

The chamber was rigidly connected (air spaces were carefully avoided) to a brass box containing a Victoreen-VX-10A thermal switch and a Raytheon CK-5889 electrometer tube. These were completely embedded in ceresin wax to prevent ionization and leakage. The box also provides for connecting a standard air capacitor into the system. The thermal switch was used as a grounding key and could be remotely controlled. The charge produced by the ionization chamber or standard capacitance is fed directly to the grid of the electrometer tube, with the entire system insulated from ground. The output of the electrometer tube is then fed into a balanced cathode follower type D.C. amplifier, the output of which is read on a vacuum tube voltmeter. The build-up of charge on the grid was used as a measure of the ionization current and therefore no grid resistor was required.

Current measurements were made with a Townsend balance circuit. In this instance, the varying voltage was applied directly across the chamber in addition to the saturation voltage, thereby utilizing the self capacitance of the chamber. The polarity of the potential was such as to produce a charge on the electrometer grid, equal and opposite to that produced by the ionization. The relationship for the current then is:

$$I = 2.463 \times 10^{-12} \frac{AT}{dP} \frac{\Delta V}{\Delta t} \text{ amp.}$$

where

- $A$  = area of collecting electrode
- $T$  = temperature in degrees absolute
- $P$  = pressure in mm. of Hg
- $d$  = spacing between electrodes in millimeters
- $\frac{\Delta V}{\Delta t}$  = volts/sec.

The spacing between the electrodes was measured electrically by incorporating the chamber in one arm of a bridge circuit.

TABLE I: SURFACE DOSE AS A FUNCTION OF FIELD SIZE FOR A 2-MVP X-RAY BEAM (h.v.l. = 7.6 mm. Pb)

Area of Field (sq. cm.)	Per Cent of Air Dose
25	14.6
64	25.6
100	30.5
144	35.4
225	43.0
324	49.2
400	52.1
625	58.0

The other arms were composed of a standard air capacitor calibrated by the National Bureau of Standards, a standard resistor, and precision resistance box. A transient signal was introduced by the closure of a key, and the null point was detected through the electrometer circuit. The standard capacitance was electrically connected to the grid at the same point as the extrapolation chamber, thereby minimizing any additional capacitance introduced by leads. The spacing may then be found from the usual relationship of the bridge components at the balance point.

The chamber was placed on a stack of Masonite approximately 50 cm. in height. This material was selected for its uniform density, which is close to unity (actual density 0.988 gm./c.c.). All absorbers used to obtain the values reported in this paper were constructed of polystyrene, which was chosen because of its density, composition, and availability in a large variety of thicknesses.

For each field size and each absorber thickness, curves of current *vs.* spacing were plotted. All values to be reported were computed by the use of data falling on the straight portion of these curves. The points plotted represent the average of both positive and negative collector potentials. In the case of small fields, in addition to extrapolating for zero spacing, extrapolation for zero collector diameter is necessary. Such data were gathered for the smallest field used ( $5 \times 5$  cm.), and from these it was determined that a collector diameter of 1.252 cm. defined a sufficiently small volume for compliance with the Bragg-Gray principle.

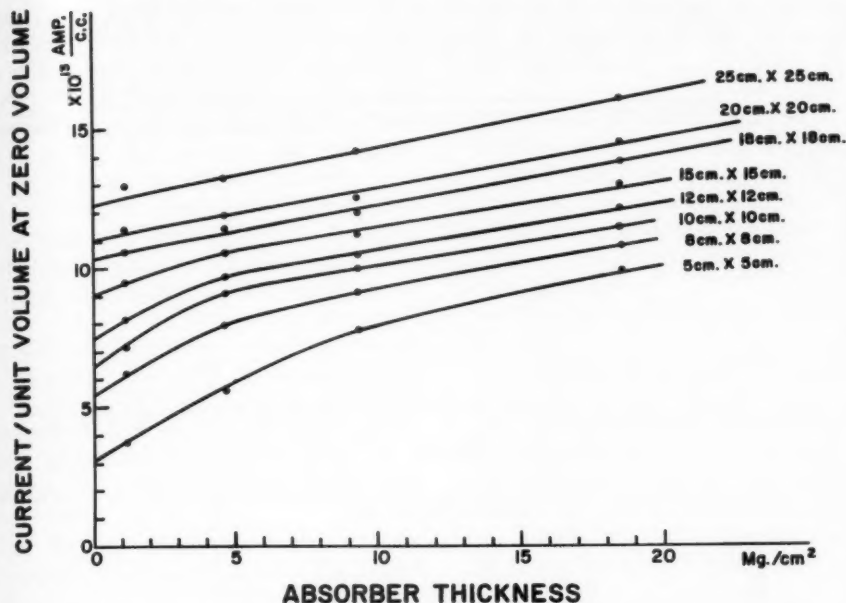


Fig. 2. Current per unit volume, extrapolated to zero volume, as a function of absorber thickness. The curves for each field size represent the values determined by the use of polyethylene and rubber hydrochloride.

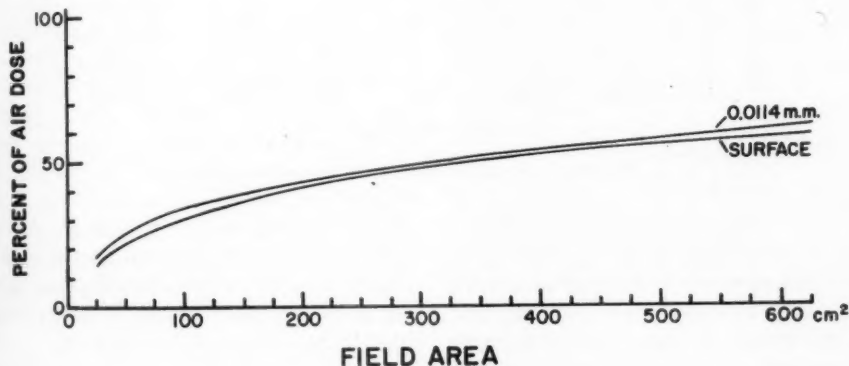


Fig. 3. Surface dose as a function of field size. The surface dose is expressed in percentage of air dose as measured with a thimble chamber whose wall thickness was sufficient to provide electron equilibrium in the air cavity. Also shown is the dose at a depth of 0.0114 mm. in unit density material.

The intensity of the x-ray beam was monitored through the use of a parallel-plate ionization chamber incorporated in the tube head.

#### RESULTS

The values determined for surface dose for the areas used are given in Table I.

These values were obtained by extrapolating the experimental results to zero film thickness. The curves showing these extrapolations are given in Figure 2. The film corresponding to a thickness of 1.14 mg./sq. cm. was made of rubber hydrochloride. All other points were measured with polyethylene films 4.67 mg./sq. cm.

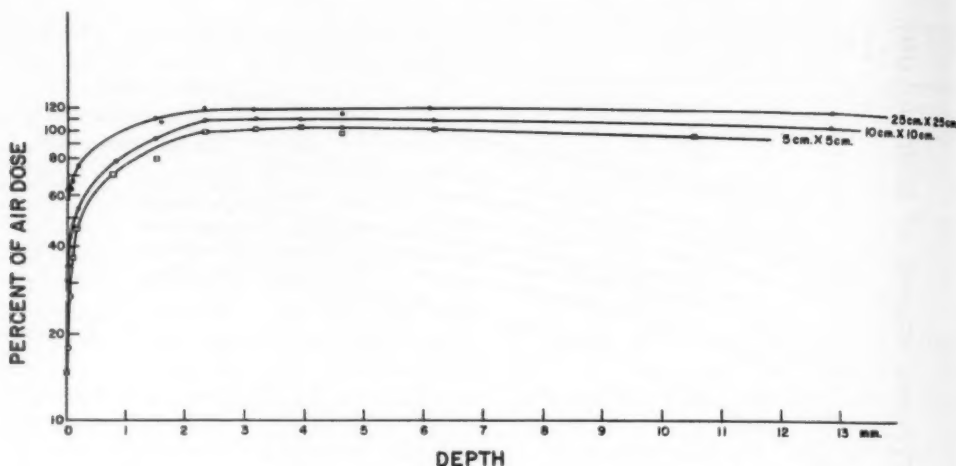


Fig. 4. Depth dose in polystyrene. The percentage depth dose shown is calculated by considering the air dose value as 100 per cent.

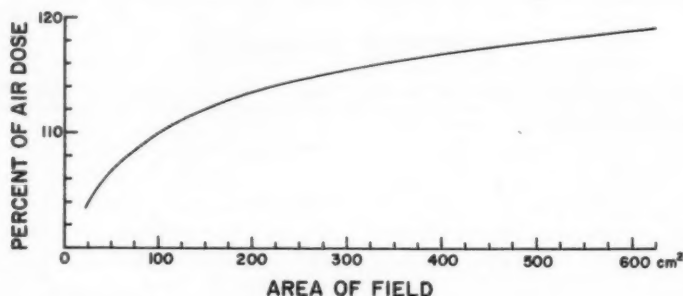


Fig. 5. Peak dose (per cent of air dose) as a function of field size.

thick. The values obtained are plotted as a function of entrance field area in Figure 3. Since there is a non-linear relationship between dose rate and field size, particularly emphasized at small areas, a degree of uncertainty in the extrapolated values exists. It is therefore interesting to compare the variation with field size of these values with those experimentally determined at a depth of 1.14 mg./sq. cm.

To determine the magnitude of the peak dose rate and its depth below the surface, polystyrene absorbing sheets were placed on top of the film. Measurements of the dose rate were made as a function of absorber thickness for field sizes of  $5 \times 5$  cm.,  $10 \times 10$  cm., and  $25 \times 25$  cm. The results of this series of measurements are

shown in Figure 4. A plot of the peak dose rate as a function of area is given by Figure 5. These values were not experimentally determined but represent values read from the curves in Figure 4.

#### DISCUSSION

The rapid build-up of ionization with the introduction of absorbing layers into the 2-MVP beam, precludes the use of thimble-type ionization chambers for surface dose measurements associated with this beam. The shape of the depth-dose curve in this region and in the vicinity of the peak cannot be obtained with a chamber whose linear dimensions are large compared with the change in dose rate over similar distances. With the extrapolation chamber,

it was found that volumes defined by a collecting area of 1.232 sq. cm. and spacings of less than 1.5 mm. were producing currents/unit volume equal to those which would have been obtained at zero volume.

It is of interest to note the changing rate of increase in ionization with field size as shown by the curves in Figure 2. This is due to a changing ratio between forward-scattered secondaries and side-scattered secondaries. This leads to a greatly reduced surface dose for small fields and consequently a much more rapidly changing dose rate with increase in the thickness of absorbing layer. This phenomenon also manifests itself by producing a smaller spread in peak dose rates than in surface dose rates as the area is increased.

The marked increase in side-scatter with increasing field size is also illustrated by the relationship of dose rate to area. For example, even changes in area in the region between 400 and 625 sq. cm. show significant increases in the surface dose rate.

The change in dose rate with absorber thickness in the region between depths of 2.5 mm. and 6 mm. is relatively small. In fact, these changes are of the same order as the experimental errors. Therefore, an exact determination of the position of the peak and the value of the dose at this point is rather difficult. Careful consideration of the data leads to a choice of  $4.0 \pm 0.25$ -mm. depth as the position

of the peak. The dose at this point, as given in Figure 5, is felt to be accurate to  $\pm 2$  per cent.

#### SUMMARY

Extrapolation chamber measurements for a 2-MVP resonant generator have been determined for a focal skin distance of 100 cm. and a half-value layer of 7.6 mm. of lead. The quantities which have been determined are:

(a) Surface dose rates as a function of field size.

(b) The depth at which the peak dosage rate occurs,  $4.0 \pm 0.25$  mm.

(c) The magnitude of the peak dosage rate as a function of field size. These have been expressed in terms of the air dose rate measured with a thimble chamber whose walls are sufficiently thick to provide electronic equilibrium.

NOTE: We are grateful to Miss Ann Tawney for her careful operation of the generator and to Dr. Edwin Gordy for the construction of the electrometer amplifier circuits and the power supplies.

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Roswell Park Memorial Institute  
Buffalo 3, N. Y.

#### REFERENCES

1. FAILLA, G.: The Measurement of Tissue Dose in Terms of the Same Unit for All Ionizing Radiations. *Radiology* 29: 202-215, August 1937.
2. BAILY, N. A., AND BEYER, N. S.: Beam Quality Determinations for a 2-Mvp Resonance Type X-Ray Generator. *Radiology* 66: 572-576, April 1956.

#### SUMMARIO IN INTERLINGUA

##### Dose de Superficie e de Entrata pro un Fasce de Radios X de 2 MVP

Mesurationes del camera pro un generator resonante de 2 MVP esseva determinate per extrapolation pro un distantia focopelle de 100 cm e un valor de medie spissitate de 7,6 mm de plumbo. Le quantitates determinate esseva le sequente:

(a) Dosage de superficie como function del dimensiones del campo.

(b) Le profundor a que le dosage maximal occorre,  $4,0 \pm 0,25$  mm.

(c) Le magnitudine del dosage maximal como function del dimensiones del campo. Iste quantitates esseva exprimate como dosage aeree, mesurate per medio de un camera con parietes sufficientemente spisse pro provider equilibrio electronic.

# Method of Dosage Calculation for Linear Radium Sources<sup>1</sup>

ELSIE R. TESTA, B.A.<sup>2</sup>

AS A ROUTINE PROCEDURE in intracavitary or interstitial radium treatment, every patient is radiographed in order to visualize the distribution of sources after implantation. Frequently it is discovered that the planned arrangement of sources differs from what is accomplished in the operating room. Sources are found to be well spaced in one region and far apart in another, so that, although one area of tumor is properly dosed, another is inadequately dosed. Sometimes the arrangement is found to be such that there are "hot spots" in regions which tolerate radiation poorly.

Of particular interest are cases of cervical cancer under treatment by an intracavitary technic, since sources in the uterus and vagina can be so situated as to deliver a harmful dose to the rectum or bladder. Meredith (1) has considered this problem in detail. Calculation of the amount of radiation reaching such points of interest is often neglected, the dose being expressed simply as the number of milligram-hours. The range is from 5,000 to as much as 13,000 mg.-hr., the usual dose being 7,000 mg.-hr. (2). Statements of dose in these terms actually are meaningless. The milligram-hour is the unit of radiation emitted by the radium and tells nothing about the amount received by the areas under consideration. Because of anatomical distortion as a result of disease, the radium may be so distributed that, in delivering a "dose" of 7,000 mg.-hr., the rectum will be injured or Point A will be over-dosed and necrosis in the paracervical triangle will result (1).

In order to carry out an intelligent system of radium treatment, doses must be estimated for such critical points as Point A, the rectum, and, in cases of severe anteversion, the bladder. The Quimby lin-

ear source tables (3) provide an accurate means of determining the contribution of each source to the point in question. These tables give the dose in roentgens per milligram-hour to a point, provided the following distances are known: (a) distance of the point from the mid-point of the source along the axis of the source; and (b) distance of the point perpendicular to the source (Fig. 1).

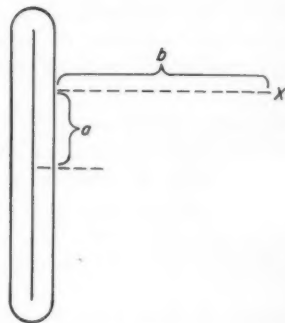


Figure 1

In cases where sources and points of interest lie in one plane, the problem is simple, measurement of the desired distances being made directly from a flat film, with correction for magnification. Most often, however, sources and points of interest comprise a three-dimensional figure and determination of the distances is complicated. In attempting their measurement by combining data from anteroposterior and lateral films, there are three sources of error: mistaken identification (a) of sources and (b) of points of interest in the lateral view in the attempt to match them with the anteroposterior view, and (c) varying magnification factors for all sources in both views. Incorrect identification of sources and points naturally leads to incorrect estimates of dosage.

<sup>1</sup> From the Physics Laboratory, Francis Delafield Hospital, New York, N. Y.

<sup>2</sup> At present, Assistant Physicist, Bellevue Hospital, New York, N. Y.



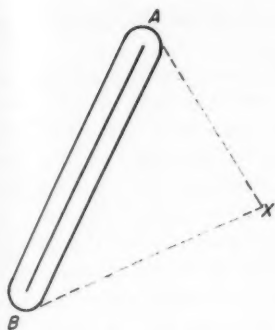


Figure 2

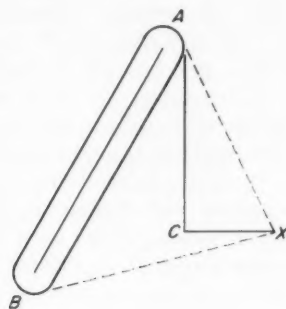


Figure 3

In addition, any attempt at calculating dose using both lateral and anteroposterior films is time-consuming. Experience thus indicated the need for a rapid, simple, accurate method for estimating dose which would allow the use of a single film, preferably in the anteroposterior projection.

Perusal of the literature revealed a dosage calculation system involving only a postero-anterior film, the so-called "tube-shift" method suggested by Lederman and Lamerton (4). The use of a "tube-shift" film, as described by these workers, suggested a practical method of finding the required distances for use with the Quimby tables. From such a film, distances from either end of the source to points of interest can be established, a triangle can be constructed on paper to show this spatial relationship, and the desired distances can be measured directly (Fig. 2).

To illustrate the use of the "tube-shift" film,  $AX$ , in Figure 2, will be used as an example. Whatever is said about  $AX$  applies to  $BX$  as well. The true distance  $AX$  is actually composed of two distances,  $AC$  and  $CX$  (Fig. 3).  $AC$  is the difference in height above the film between the source and the point of interest.  $CX$  is the distance between the end of the source and the point of interest as it appears on the film, corrected for distortion.

The tube-shift film allows the determination of height above the film for both sources and points of interest. The geometric proof is furnished by Figure 4, where

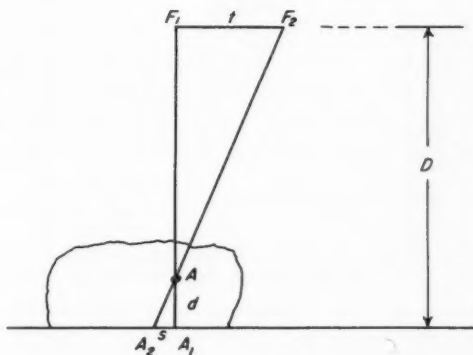


Figure 4

- $D$  = Known target-film distance
- $A$  = Point of interest
- $F_1$  = Position of focal spot for first exposure
- $F_2$  = Position of focal spot for second exposure
- $t$  = Known tube shift
- $A_1$  = Image on film as result of first exposure
- $A_2$  = Image on film as result of second exposure
- $d$  = Height of  $A$  above film

$AF_1F_2$  and  $A_2A_1A$  are similar triangles. Since this is so, their corresponding sides bear a constant ratio to each other, namely:

$$\frac{t}{s} = \frac{(D - d)}{d}$$

$$d = \left( \frac{s}{t + s} \right) D. \quad (1)$$

$A_2A_1$ , or  $s$ , can be measured directly from the film. This is the so-called "image shift." By substitution in Equation 1,  $d$  can be determined. This calculation is applied to both ends of each source and to the points of interest.

Since the relationship between height above the film and image shift is defined by Equation 1, it is possible to construct a curve by substituting in the equation varying values of  $s$  and the known target-film and tube-shift distances. This makes it possible to find height above film without a separate calculation each time. Such a curve is shown in Figure 5. It might be mentioned at this point that, if one decides to change the operating conditions, *i.e.*, target-film distance or tube-

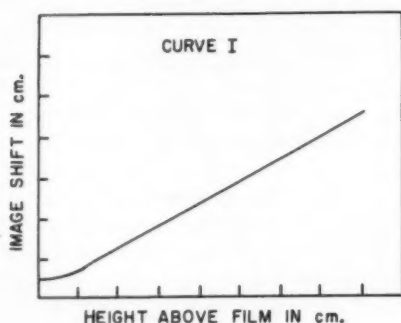


Figure 5

shift distance, a new curve will have to be drawn for those particular conditions.

The distance  $CX$  (hereinafter referred to as "projected distance") is the projection between the end of the source and the point of interest (as it appears on the film), corrected for distortion. From Figure 6 it can be seen that the amount of distortion will vary with height of the point above the film. Actually, the figure shows a somewhat exaggerated picture of what really occurs.

The beam, which originates from a target which is perhaps 2 sq. mm., diverges considerably by the time it has traveled a distance of 40 inches to the film. However, the rays which produce the image of the radium implant on the film are those in the central part of the beam and are, for all practical purposes, parallel to each other and perpendicular to the plane of the film. This means that the images on the film were produced by a beam which gave almost orthogonal projection. There is, nonetheless, a small correction which must be

applied to most of the distances projected on the film.

From the foregoing discussion, it can be assumed that the rays which produce the images on the film are those which are parallel to the central ray and close to it. Also, the distance  $AX$  is approximately bisected by these rays. Figure 6 is a geometric representation of this situation and can be used to calculate distances  $y$  and  $z$ , which are the small distortions occurring when the distance  $AX$  is projected on the

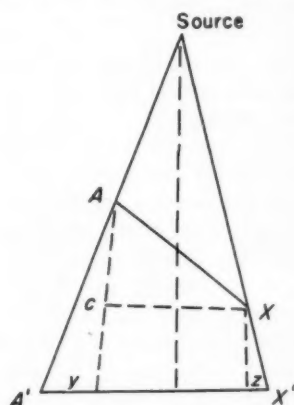


Figure 6

film. From Figure 6 it can be seen that:

$$\frac{\text{target-film distance}}{\text{half of projected distance}} = \frac{\text{height of point above film}}{\text{amount of distortion}} \quad (2)$$

In other words, for a particular projected distance, a correction factor can be derived by dividing the target-film distance by half of the projected distance. Hence, it is possible to construct a curve giving the correction factor to be applied on the basis of the relationship in Equation 2. An example will best illustrate the principle.

In Figure 7, the upper end of a source has been calculated to be 17.0 cm. above the film and the point of interest 6.0 cm. above the film. The distance between the upper end of the source and the point of interest is measured on the film as 7.8 cm. The target-film distance is 101.5 cm.

To find  $y$ :

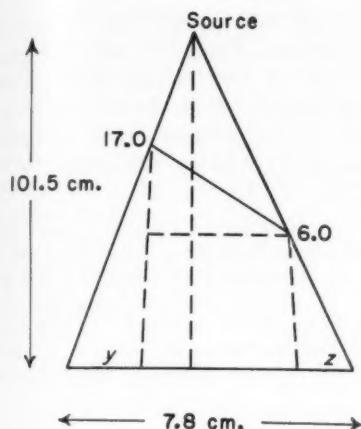


Figure 7

$$\frac{101.5}{3.9} = \frac{17.0}{y}$$

$$\text{constant} = \frac{\text{height above film}}{y}$$

$$y = \frac{\text{height above film}}{\text{constant}}$$

To find  $z$ :

$$\frac{101.5}{3.9} = \frac{6.0}{z}$$

$$\text{constant} = \frac{\text{height above film}}{z}$$

$$z = \frac{\text{height above film}}{\text{constant}}$$

To derive the values for making the curve which correlates projected distance and the correction factor to be applied, divide 101.5 by 2, 4, 5 etc. (*i.e.*, possible projected distances). Such a curve would resemble

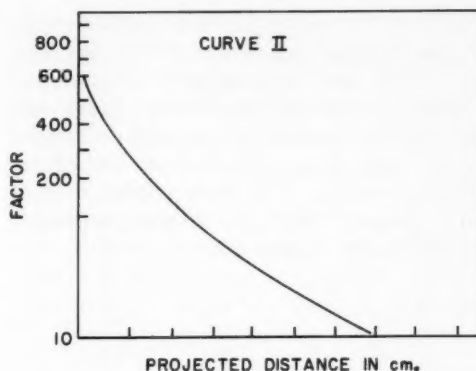


Figure 8

that reproduced in Figure 8. The correction factor obtained from Curve II can then be related to the heights above film, as follows: In the illustrated case:

$$\frac{17 + 6}{\text{correction factor}} = \text{correction to be applied to } 7.8.$$

By now, the distances  $AC$  and  $CX$  have been established:  $AC$  by finding the difference in height between  $A$  and  $X$ ;  $CX$  by measuring the projected distance between the point of interest and source end and correcting it for distortion. If the two distances are combined perpendicularly, the true distance  $AX$  can be determined. The next step, therefore, consists in laying off, perpendicular to each other, the distances  $AC$  and  $CX$ , as in Figure 9.

As the last step, the triangle which shows the point of interest in relation to a particular source is constructed. This is done by laying off a line equal to the total

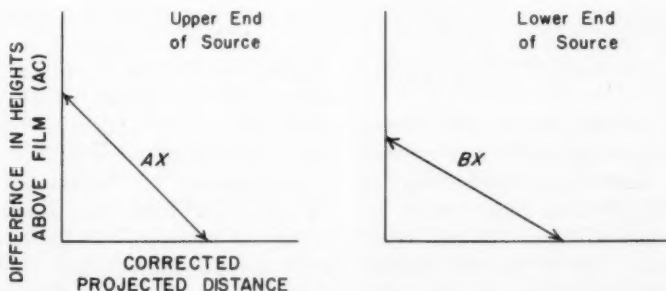


Figure 9

length of the source. (Total source length is used because this is really what one sees on the film and has been used for all measurements made on the film.) From one end, an arc is swung whose radius is equal to  $AX$  and from the other an arc whose radius is  $BX$ . The intersection of the arcs represents the point in space as related to the source (Figure 10).

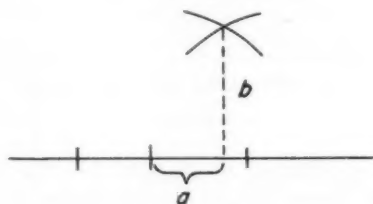


Figure 10

Now, it is necessary only to measure directly on this diagram the required distances for use of the Quimby linear source tables.

In summary, only the following steps are necessary:

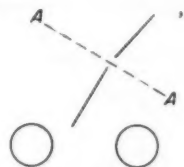
*To produce the required film:* An anteroposterior exposure is made with the tube focus situated directly over the radium implant, as nearly as can be determined, and at a known height. The focus is then shifted a known distance laterally and another exposure is made. Experience has shown that a 4-inch tube shift gives good separation of the two images which will appear on the film. A target-film distance of 40 inches is used.

*To locate points of interest:* Preferably, points of interest should be marked in the patient with radon seeds, clips, etc., at operation. Sometimes, however, it is impossible to put a marker in the patient, and other methods must be used to locate points of interest.

In uterine cervix cases, Point A has been set forth by Tod and Meredith as a critical point, being in a zone where overdosage is dangerous and in the area where early infiltration of cancer occurs. It has been defined as "2 cm. lateral to the central canal of the uterus and 2 cm. up from the mucous membrane of the lateral fornix in

the axis of the uterus" (5). From this definition then, Point A can be assigned a "height above film" equal to that which was calculated for the lowest tube in the tandem. Its exact location on a film is accomplished as follows, according to Meredith (6).

"Go 2 cm. up from the lower end of the tandem, and then 2 cm. laterally on either side. . . . This is for the normally placed uterus. . . . but we accept it that if the uterus is pulled over to one side it carries its Points A with it and therefore we would calculate for



Bladder and rectum can be made radiopaque by a simple technic. Before any radiographic exposures are made, with the patient on the diagnostic table, about 50 c.c. of 10 per cent Neo-Iopax is instilled into the bladder through a catheter, and evacuated. This renders the bladder sufficiently opaque for demonstration on film. About 150 c.c. of 2 per cent barium solution is introduced into the rectum and excreted. This makes the bowel radiopaque, but the density is not enough to obliterate the images of the radium sources.

For radium implants other than in the uterine cervix, critical points can be selected and assigned "heights above film" on the basis of known relationships to specific sources or anatomical structures.

*To prepare required curves:* Curve I is prepared from Equation 1, substituting the particular target-film distance and tube shift selected. Curve II is prepared according to the instructions given in the section of this paper which discusses relationship of distortion to target-film distance, height above film, etc.

*Calculation:* 1. Measure "image shift" for upper and lower end of each source and points of interest. Refer to Curve I for their heights above film. (In the specific cases where critical points are selected on the film and assigned a "height above

film"—e.g., Point A—this step is not necessary. Find the difference between points of interest and source ends.

2. Measure "projected distance," i.e., distance between point of interest and source ends (both upper and lower). Refer to Curve II for correction factor to be applied. Then

$$\frac{\text{height above film of source end} + \text{height above film of critical point}}{\text{correction factor}}$$

= correction to be applied to projected distance (or the amount to be subtracted from the projected distance).

3. On rectilinear graph paper lay off, perpendicular to each other, the distances obtained in steps 1 and 2 for each source.



4. Having established the true distance from either end of the source to the point of interest, lay off a straight line equal in length to the total length of the source. From one end swing an arc whose radius is equal to  $AX$ . From the other end swing an arc whose radius is equal to  $BX$ . The resulting figure shows the point of interest in relation to the particular source being considered.

5. Measure directly from the figure in step 4 those distances necessary for use of the Quimby linear source tables.

#### SUMMARY

A method of calculating radium dosage is presented. It requires only one film, which can be made in any x-ray department. It requires no special positioning apparatus, or mathematical skill. It is rapid. From geometric relationships, the distances between both ends of the source and critical points are established and a triangle is constructed to show the spatial relationship. From this drawing the distances necessary for use of the Quimby tables are obtained and dosages determined.

The method was tested by constructing models of radium implants. Calculated distances were checked against measured distances. The error amounted to 5 per cent or less.

Bellevue Hospital Center  
First Ave., and 27th St.  
New York 16, N. Y.

#### REFERENCES

1. MEREDITH, W. J.: Dosage Distribution and Dosage in Carcinoma of the Uterine Cervix. *Radiology* **54**: 386-390, March 1950.
2. FLETCHER, G. H., ET AL.: A Physical Approach to the Design of Applicators in Radium Therapy of Cancer of the Cervix Uteri. *Am. J. Roentgenol.* **68**: 935-947, December 1952.
3. GLASSER, O., QUIMBY, E. H., TAYLOR, L. S., AND WEATHERWAX, J. L.: *Physical Foundations of Radiology*. New York, Paul B. Hoeber. 2nd ed., 1952. Pp. 353-356.
4. LEDERMAN, M., AND LAMERTON, L. F.: Dosage Estimation and Distribution in the Radium Treatment of Carcinoma of the Cervix Uteri. A New Method and Its Clinical Applications. *Brit. J. Radiol.* **21**: 11-26, January 1948.
5. TOD, M., AND MEREDITH, W. J.: Treatment of Cancer of the Cervix Uteri—A Revised "Manchester Method." *Brit. J. Radiol.* **26**: 252-257, May 1953.
6. MEREDITH, W. J.: Personal communication, Aug. 15, 1956.

#### SUMMARIO IN INTERLINGUA

##### Methodo de Calculation de Dosage pro Fontes Linear de Radium

Es describe un methodo pro calcular le dosage livrate a varie punctos de interesse per implantas de radium, con application particular al irradiation intracavitari in cancro cervical. Illo usa un sol pellicula a tubo viagiante que es obtenite con un distantia de 40 pollices inter pecia de concentration e pelle. Super le base de relationes geometric, le distantias es establite inter le un e le altere extremitate del fonte

e certe punctos critic (como Puncto A, le recto, e le vesica), e un triangulo es construite pro mostrar le relationes spatial. Iste construction forni le distantias pro determinar le dosage per medio del tabulas de Quimby pro fontes linear. Le methodo esseva essayate con modelos de implantas de radium, e il esseva trovate que le error de mesuration non excede 5 pro cento.



# A Case of Hemangioma (Angiomatosis) of the Small Intestine and Mesentery

## A Radiographic Clue to Diagnosis<sup>1</sup>

SAMUEL H. MADELL, M.D.

EXCELLENT REVIEWS and classifications of vascular tumors of the gastrointestinal tract have been provided by Gentry *et al.* (2), Hansen (3), and others. Mention is made of the diagnostic value of phleboliths within the tumors, but pre-operative or antemortem diagnosis appears

### CASE REPORT

A 75-year-old Negro had been seen intermittently in the clinics of the Presbyterian Hospital (New York) over a period of six years for symptoms of myocardial insufficiency. He was first hospitalized on April 19, 1956, because of increasing left anterior chest pain associated with dyspnea. He had lost 20 to 30 pounds in the past year, presumably from



Fig. 1. Barium enema study: post-evacuation film. A group of calcifications which resemble phleboliths is seen in the right lower quadrant. The tip of the cecum is cephalad to the calcifications.

Fig. 2. Small intestine study. The phleboliths are encircled by an abnormal loop of proximal ileum which contains many small irregular filling defects.

rarely to be obtained. Two cases of hemangioma of the colon have been reported, one by Hollingsworth (4) and one by Bailey, Barrick and Jenkinson (1), in which a correct preoperative diagnosis was made. It is the purpose of the present paper to emphasize the diagnostic value of unusual localized clusters of phleboliths in the abdomen as a sign of unsuspected hemangioma of the ileum and mesentery.

diating. Except for frequency of urination for two months and a history of malaria in 1903, the past history and system review were non-contributory. Physical examination disclosed inspiratory râles at the bases of both lungs and occasional expiratory wheezes. On percussion the heart was found to be slightly enlarged, and there was a blowing systolic murmur at the apex. No masses were palpated in the abdomen. The prostate was enlarged, indurated, and slightly nodular.

Laboratory tests revealed a hypochromic, microcytic anemia. The hemoglobin was 8 gm. per 100

<sup>1</sup> From the Department of Radiology of the Presbyterian Hospital and of the College of Physicians and Surgeons, Columbia University, New York, N. Y. Accepted for publication in December 1956.

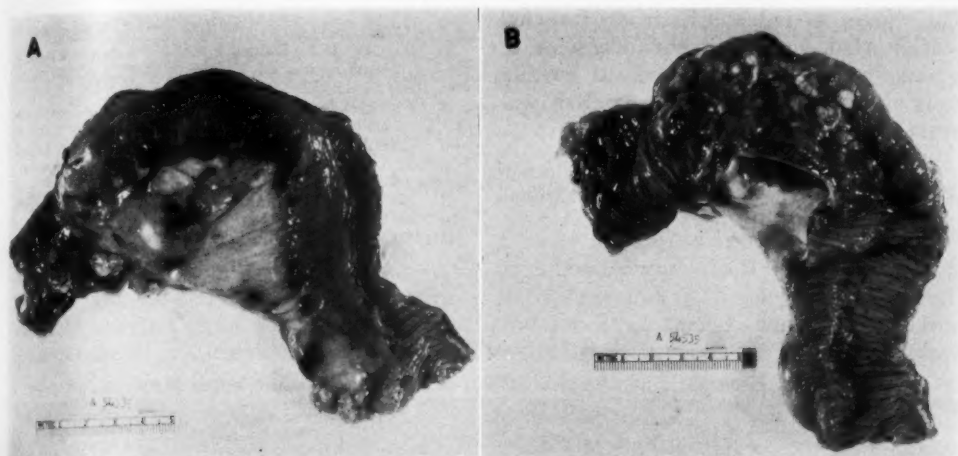


Fig. 3. Photograph of the specimen. A. Serosal aspect with attached mesentery. B. Mucosal aspect.

c.c., the red blood count 2,950,000 per c.mm., the hematocrit 27 per cent, and the erythrocyte sedimentation rate 70 mm. in an hour. The electrocardiogram showed evidence of a healed myocardial infarct. Examination of the stools for occult blood was negative. The serum acid phosphatase was 4.1 and 6.1 Gutman units on 2 occasions. A perineal punch biopsy showed anaplastic carcinoma of the prostate. The patient was therefore treated with stilbestrol, and orchiectomy was recommended.

Because of the unexplained hypochromic anemia and elevation of the sedimentation rate, an investigation of the gastrointestinal tract was undertaken. The barium enema study showed no abnormalities of the colon, but revealed a group of small, round calcifications varying from 3 to 8 mm. in diameter in the right lower quadrant (Fig. 1). The close grouping of the calcifications, which resembled phleboliths, in an unusual location suggested that they might lie within a vascular tumor, and an examination of the small intestine was recommended. This showed the zone of phleboliths to be encircled by and closely associated with an abnormal loop of proximal ileum, which contained many small irregular filling defects and was of irregular caliber (Fig. 2).

Laparotomy was performed, and a tumor measuring approximately 10 cm. in diameter was found, involving the proximal ileum and its adjacent mesentery. A segment of small intestine 24 cm. long was resected. The wall of the central portion was studded for a distance of 8 cm. by numerous black, soft, collapsible masses measuring up to 1 cm., and filled with blood (Figs. 3, A and B). Two similar areas measuring 1 and 2 cm. in their greatest dimension were present in the adjacent mesentery. The mucosal aspect also showed grossly non-ulcerated masses, bulging into the lumen. Firm, discrete, somewhat movable masses measuring 2 to 3

mm. could be palpated within the nodular tissue. These were thought to represent foci of calcification.

Microscopic examination disclosed clusters of vascular spaces throughout the thickness of the bowel wall. Most of these were thin-walled and analogous to veins; some were thick-walled with well organized smooth muscle and elastic fibers, analogous to arterial structures. Thrombosis, in some instances with calcification, was of frequent occurrence. The mesenteric lesions were similar, although the vessels were entirely of the thin-walled venous variety.

Since the vessels in this tumorous, vascular proliferation resembled both veins and arteries, the lesions were classified pathologically as angiomatosis.

#### COMMENT

Mucosal ulceration and bleeding are said to be frequent in vascular tumors of the small intestine. Gentry found evidence of bleeding in 19 per cent of benign and 20 per cent of malignant vascular small intestinal tumors. In the case reported here there was no history of gastrointestinal bleeding and the examination of the stools for occult blood was negative. Nevertheless, the presence of an unexplained hypochromic microcytic anemia prompted the search for a source of bleeding in the gastrointestinal tract. Although barium study of the small intestine would have led to the discovery of the lesion in this case, it might have failed had the tumor been smaller. It was the radiographic finding

of a cluster of phleboliths in an unusual location that suggested the diagnosis of hemangioma, and prompted a barium study of the small intestine in search of confirmatory evidence.

NOTE: The author acknowledges his indebtedness to Dr. Nathan Lane for help in the description of the specimen.

2 E. 77th St.  
New York 21, N. Y.

#### REFERENCES

1. BAILEY, J. J., BARRICK, C. W., AND JENKINSON, E. L.: Hemangioma of Colon. *J.A.M.A.* **160**: 658-659, Feb. 25, 1956.
2. GENTRY, R. W., DOCKERTY, M. B., AND CLAGETT, O. T.: Collective Review: Vascular Malformations and Vascular Tumors of Gastrointestinal Tract. *Internat. Abstr. Surg.* **88**: 281-323, 1949; in *Surg., Gynec. & Obst.*, April 1949.
3. HANSEN, P. S.: Hemangioma of the Small Intestine with Special Reference to Intussusception. *Am. J. Clin. Path.* **18**: 14-42, January 1948.
4. HOLLINGSWORTH, G.: Hemangiomatous Lesions of the Colon. *Brit. J. Radiol.* **24**: 220-222, April 1951.

#### SUMMARIO IN INTERLINGUA

#### Un Caso de Hemangioma (Angiomatosis) del Intestino Tenue e del Mesenterio

#### Indice Radiographic pro le Diagnose

Le caso hic reportate signala le valor diagnostic de inusual congregationes localisate de phlebolithos in le abdomine como signo de hemangioma del ileo e mesenterio. Un studio a clyster de barium esseva effectuate in un homine de 75 annos de etate a causa de un non explicate anemia hypochromic e acceleration del sedimentation erythrocytic. Illo revelava un gruppo de parve ronde calcificationes in le quadrante dextero-inferior del abdomine. Un studio del intestino tenue monstrava que le calcificationes esseva incirculate per un anormal spira de ileo que contineva multe parve defectos de plenation e habeva un calibre irregular.

Laparotomia revelava le presentia de un tumor que afficeva le ileo proximal

e su mesenterio adjacente. Un segmento del intestino esseva excidite. Il esseva constatate que iste segmento esseva interlardate de numerose nigre e molle massas que esseva collapsibile e contineva sanguine. Le adjacente mesenterio exhibiva le mesme phenomeno. Etiam le aspecto mucosal monstrava grossiermente non-ulcerate massas que protrudeva a in le passage interior. Le formationes interpretate como focos de calcification esseva palpabile intra le histo nodular.

Le examine microscopic del specimen revelava racemos de spatios vascular ab un latere del pariete intestinal al altere. Proque istos resimilava venas e etiam arteries, le lesiones esseva classificate como angiomatoses.



# Lesser Omental Bursa Abscess Simulating Gastric Neoplasm

Report of a Case<sup>1</sup>

HARRY NEWMAN, M.D., and LOUIS H. FRISCHE, M.D.

THE SUBPHRENIC space, lying below the diaphragm, above the transverse colon, is divided into upper and lower compartments by the liver. On the left side, the lower compartment has two subdivisions, separated from each other by the lesser omentum, stomach, and anterior

of the subphrenic space, usually being secondary to inflammation elsewhere. Of a series of 3,533 subphrenic abscesses collected by Ochsner (1) 31 per cent originated in the appendix, 29 per cent in the stomach and duodenum, and 13 per cent in the liver and biliary passages; 25 per cent repre-



Fig. 1. Upper gastrointestinal series: anteroposterior and right anterior oblique views, January 1952. Normal stomach and small bowel.

layers of the greater omentum. One of these two inferior subdivisions is located anteriorly; the other lies posteriorly and is commonly called the lesser omental bursa, the foramen of Winslow providing its only communication with the greater omental sac or peritoneal cavity.

Infection followed by abscess formation may occur in any of the subdivisions

sented extension of thoracic lesions into the subphrenic space, and 2 per cent were secondary to trauma.

In 1,531 of the cases cited above, for which details were available, more than 70 per cent of the abscesses were on the right side. Approximately 4 per cent were found in the left superior and 20.5 per cent in the left anterior-inferior space. Involvement

<sup>1</sup> From the Department of Radiology, University of Oregon Medical School, Hospitals and Clinics, Portland, Ore. Accepted for publication in May 1957.



Fig. 2. Upper gastrointestinal series: routine right anterior oblique view, February 1957. Large defect in the gastric fundus and pars media suggesting gastric neoplasm.

of the left posterior-inferior space (the lesser omental sac) was relatively rare, being reported in only 3 per cent of the cases. This experience was confirmed in the series of 118 cases published by Hochberg (2), who found 12.5 per cent of the abscesses on the left side; of these, less than one-third were in the lesser omental sac.

#### CASE REPORT

A 72-year-old white male was admitted to Multnomah County Hospital because of constant dull, aching pain in the left upper and mid-abdomen. He complained of early satiety, poor appetite, nausea, and occasional vomiting of two months duration, associated with a weight loss of approximately 15 pounds. He denied recent melena, hematemesis, constipation, and diarrhea.

Five years prior to the present illness there had been an episode of hematemesis. An upper gastrointestinal series showed no abnormality at that time (Fig. 1). There were no subsequent gastrointestinal complaints and the past history was otherwise non-contributory.

The patient appeared alert and co-operative, and in no acute distress. The blood pressure was 190/84; pulse rate 90, with evidence of auricular fibrillation; oral temperature 98.4° F. Heart tones were distant, and no murmurs were audible. On abdominal examination the liver edge was palpable 3 cm. below the costal margin, soft and slightly blunted. No abnormal masses were felt and there was no tenderness to palpation. The remainder of the physical examination was not remarkable.

Laboratory findings were as follows: hemoglobin

14.3 gm., red blood cell count 4,800,000, white cell count 7,500 with normal differential, sedimentation rate 3/46; serology and urinalysis normal; free acid in the gastric contents.

There was no radiographic abnormality of the chest. An upper gastrointestinal series revealed a large mass protruding into the gastric fundus and pars media (Fig. 2). The margins of the mass were smooth, sharply defined and curvilinear in contour. No surface ulcerations were identified. The lesion appeared to arise from the posterior wall of the stomach, extending from the cardia to the incisura angularis (Fig. 3). The duodenal cap and visualized segments of small bowel were normal.

On the basis of the radiographic findings, an exploratory laparotomy was performed, with a pre-operative diagnosis of gastric neoplasm. The liver was found to be contracted and nodular, suggesting cirrhosis. The gallbladder was soft, compressible, and without stones. The small and large bowel, as well as the kidneys, were palpably normal. A large mass involved the posterior wall of the gastric fundus and the pars media and was adherent to the body and tail of the pancreas and to the hilus of the spleen. In gaining access to the lesser sac, by dissection of the greater omentum from the transverse colon and freeing the adhesions to the pancreas, an abscess was encountered within the mass. Approximately 400 c.c. of greenish-yellow pus were aspirated from the cavity. At this point, a gastrotomy was performed and the gastric mucosa was shown to be intact. Although a thorough search of the abdomen was made, the site from which the abscess originated could not be found. The involved segment of the greater curvature of the stomach was then excised. A feeding jejunostomy was created in the anti-mesenteric border of the jejunum. Three Penrose drains were placed beneath the diaphragm in the lesser omental sac and were brought out through a large stab wound in the left upper quadrant. Postoperative recovery and convalescence were uneventful.

Microscopic examination of the abscess contents demonstrated gram-positive cocci; culture produced alpha streptococci. Pathologic analysis of the specimen revealed a spherical unilocular abscess, measuring approximately 7 cm. in diameter. The attached stomach wall was intact throughout, and no ulceration or perforation could be identified. The rugal structure was flattened and the mucosa appeared rather granular and dull, but was free of defects. No evidence of neoplasm was found in any of the microscopic sections.

#### COMMENT

The cardinal signs in the roentgen diagnosis of a subphrenic abscess are elevation and immobility of the diaphragm, pleural effusion, basilar pneumonitis, and an infradiaphragmatic air-fluid level. It





Fig. 3. Stomach, "spot films," February 1957, showing sharply defined lesion apparently within the gastric lumen, interpreted as an intramural tumor arising from the posterior wall of the stomach. At surgery, the defect was found to be result of extrinsic pressure by a lesser omental sac abscess.

has been demonstrated (3) that gas within the cavity is the most conclusive radiographic evidence of an abdominal abscess. However, only 25 per cent of such abscesses

show this sign; even then it may be difficult, if not impossible, to differentiate the gas from gastric or colonic contents. An elevated and paralyzed diaphragm, a

characteristic finding rarely absent in *right* subphrenic abscess, was demonstrated in only 18 of 30 abscesses on the left (4). Only 2 of these cases showed gas accumulation with an air-fluid level.

Extragastric tumors may displace the stomach in any direction or cause compression resulting in a localized area of semi-translucency. Adrenal, pancreatic, and renal neoplasms, aortic aneurysms, and omental cysts may all produce pressure deformities of the stomach. In addition the foramen of Winslow may become sealed by an inflammatory exudate, with fluid accumulation and distention of the lesser sac to such a degree as to cause gastric displacement or deformity.

The notable feature of the case presented here was the atypical gastric deformity which suggested the presence of a neoplasm. Whereas a review of the literature reveals numerous instances of organ displacement due to a contiguous abscess, no reference is

made to the type of gastric filling defect herein described.

#### CONCLUSION

A case is presented of a lesser omental sac abscess, the sole roentgenographic evidence of which was extrinsic deformity of the stomach suggesting an intramural gastric neoplasm.

University of Oregon Medical School  
3181 S. W. Sam Jackson Park Road  
Portland 1, Ore.

#### REFERENCES

1. OCHSNER, A., AND DeBAKEY, M.: Subphrenic Abscess: Collective Review and Analysis of 3,608 Collected and Personal Cases. *Internat. Abstr. Surg.* **66**: 426-438, 1938; in *Surg., Gynec. & Obst.*, May 1938.
2. HOCHBERG, L. A.: Diagnostic Criteria for Subphrenic Abscess Based upon a Study of 139 Cases. *Ann. Int. Med.* **17**: 183-205, August 1942.
3. WEENS, H. S.: Gas Formation in Abdominal Abscesses: A Roentgen Study. *Radiology* **47**: 107-115, August 1946.
4. NEUHOF, H., AND SCHLOSSMANN, N. C.: Left Subphrenic Abscess. *Surg., Gynec. & Obst.* **75**: 751-758, December 1942.

#### SUMMARY IN INTERLINGUA

##### **Abscesso del Bursa del Omento Minor, Simulante Neoplasma Gastric: Reporto de Un Caso**

Es presentate un caso de abscesso del bursa del omento minor. Le sol signo roentgenologic del abscesso esseva un deformitate extrinsec del stomacho que suggereva le presentia de un neoplasma gastric intramural. Le fonte del infection non poteva esser determinate.

Un revista del litteratura revela numerose casos de displaciamento de un organo in consequentia de un contigue abscesso subphrenic, sed nulle reporto poteva esser trovate de un defecto de plenation gastric del typo vidite in le presente caso.



## Rates of Venous Absorption of Carbon Dioxide and Air Used in Double-Contrast Examination of the Colon<sup>1</sup>

GEORGE LEVENE, M.D.

IT HAS BEEN SHOWN elsewhere (1) that carbon dioxide is superior to air as a contrast medium for roentgenologic examination of the colon, having the following advantages:

1. Carbon dioxide is absorbed more rapidly than air. This reduces the duration of discomfort for the patient.

The following simple experiment was performed to confirm facts already established and to obtain graphic proof concerning the rates of absorption of carbon dioxide and of air from the colon.

A normal, healthy young woman was selected from a group of volunteers. The colon was first prepared for the examina-

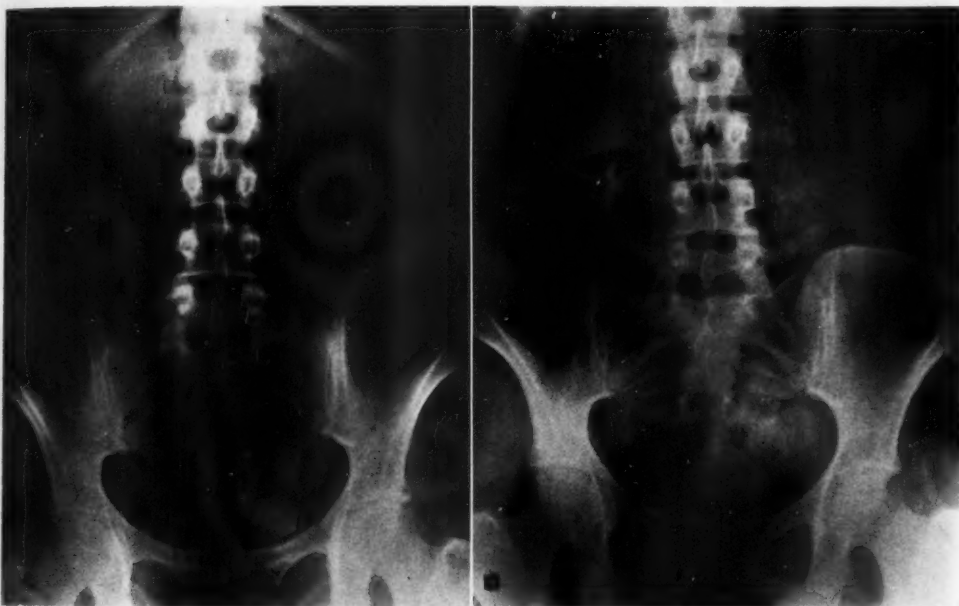


Fig. 1. Control films. The colon was prepared for this study by the administration of a laxative. A. Before introduction of carbon dioxide. B. Before introduction of air.

2. If the gas should accidentally enter a patulous bleeding vessel, there is no danger of embolus, since carbon dioxide combines with hemoglobin and goes into solution in the plasma immediately upon entering the blood stream.

3. In case of accidental perforation of the bowel, carbon dioxide is quickly absorbed from the abdomen or planes of dissection.

tion by the administration of a laxative. A control film prior to the introduction of gas into the colon showed the latter to be virtually empty (Fig. 1). The flow-meter on a tank of compressed carbon dioxide was set for a flow of one liter a minute and the gas was allowed to enter the colon under fluoroscopic observation. When the colon appeared to be properly distended, the gas supply was shut off.

<sup>1</sup>From the Departments of Radiology, Massachusetts Memorial Hospitals and Boston University School of Medicine. Accepted for publication in May 1957.

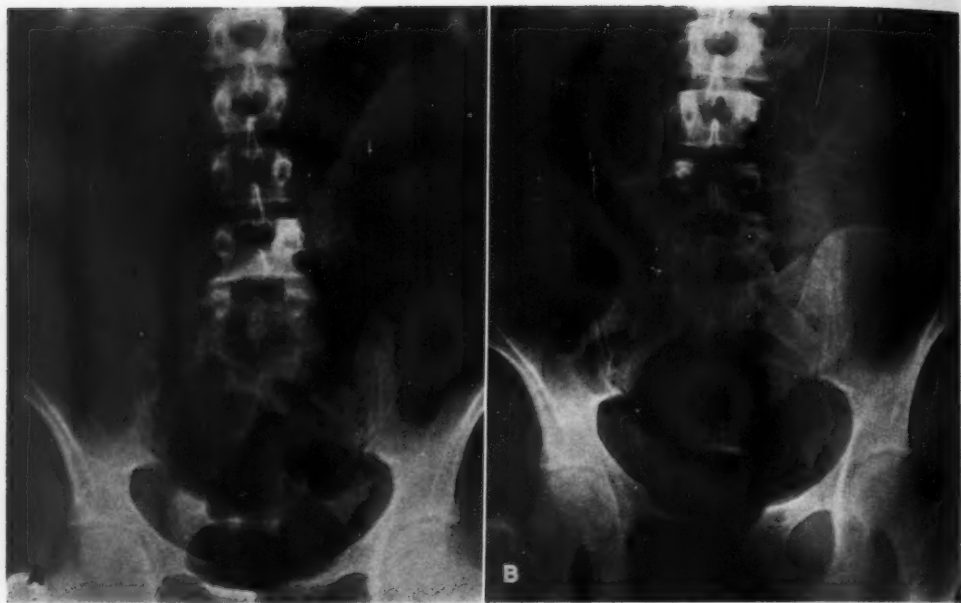


Fig. 2. A. The colon is filled with carbon dioxide: rate of flow, 1 liter per minute; duration of flow, 36 seconds. B. The colon is filled with air. The amount of gas is essentially the same as in "A".

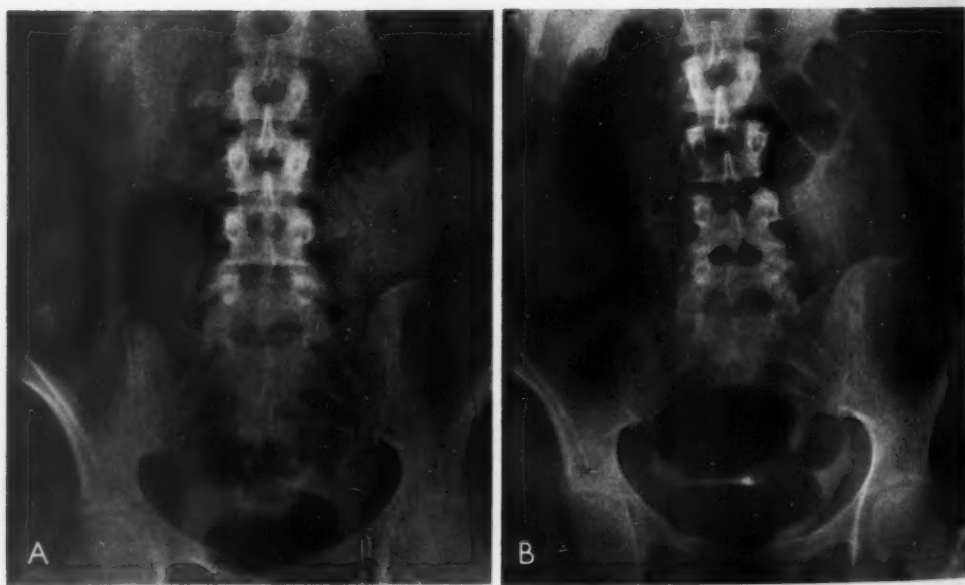


Fig. 3. Fifteen minutes after introduction of gas into the colon; none expelled by rectum. A. Carbon dioxide. Note beginning absorption from cecum. B. Air. There is no apparent absorption.

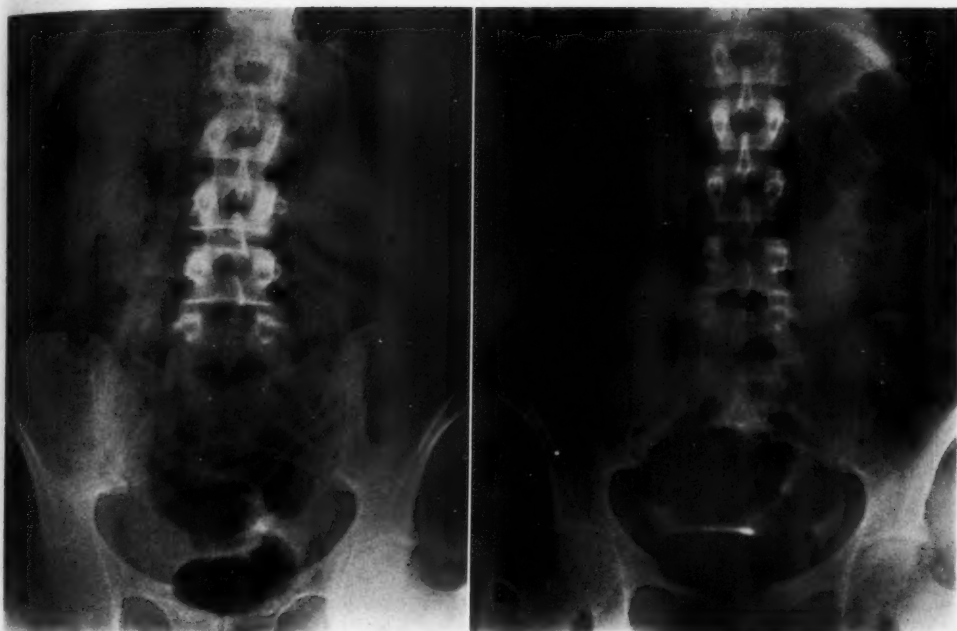


Fig. 4. Thirty minutes after introduction of gas. A. Carbon dioxide. The gas has been almost completely absorbed from the proximal colon. The gas-distended rectal ampulla confirms the fact that no gas was expelled by rectum. B. Air. No significant change in the gas content of the colon.



Fig. 5. Forty-five minutes after introduction of gas. A. Carbon dioxide. A small amount of gas remains in the descending colon and rectum. B. Air. The cecum and ascending colon are more distended, due to spasm of the descending colon. There has been very little, if any, absorption.





Fig. 6. One hour after introduction of gas. A. Carbon dioxide. There has been further absorption and redistribution of the gas in the large intestine. Effective sphincter control and the erect position have caused the gas to rise in the colon. B. Air. The amount and distribution of gas are essentially unchanged.

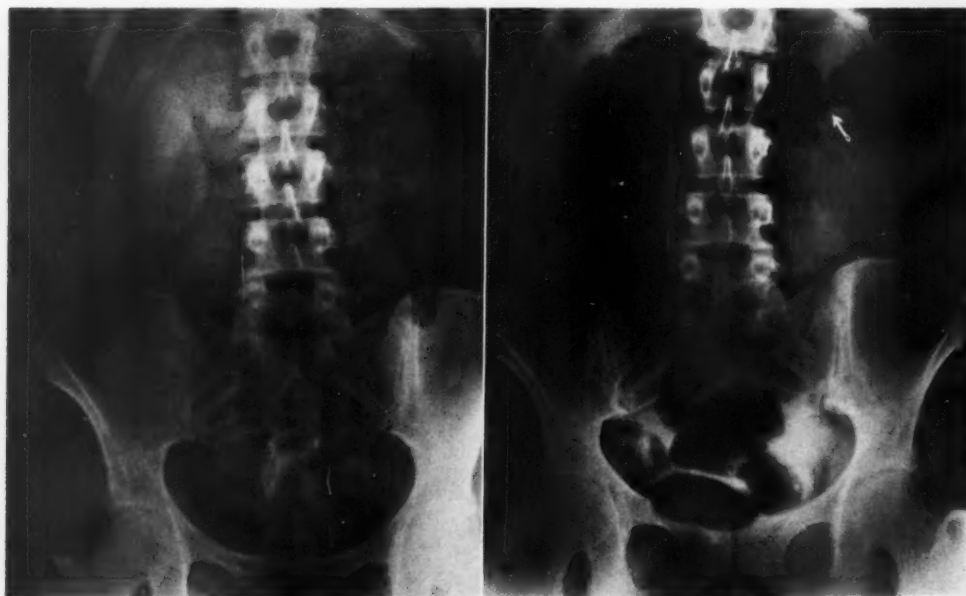


Fig. 7. Two hours after introduction of gas. A. Carbon dioxide. There is very little more residual gas in the colon than was present on the control film taken before the introduction of gas (Fig. 1, A). B. Air. There has been further distention of the cecum and ascending colon due to concentration of air in this segment. Note spasm at Cannon's point (arrow). Most of the air introduced into the colon is still unabsorbed (compare with Fig. 2, B).

The elapsed time, as determined by a stopwatch, was thirty-six seconds. Thus, approximately 600 c.c. of carbon dioxide were introduced into the colon.

A film of the distended colon was made immediately and subsequent films were obtained at fifteen-minute intervals for one hour, and an additional film at two hours (Figs. 2-7). The subject was requested to retain the gas, since any discharge by rectum would vitiate the accuracy of the study. While the young woman was thoroughly co-operative and dependable, the writer imposed a further aesthetic control by remaining present throughout the period of observation.

The entire procedure was surprisingly free from subjective discomfort. Since the gas was supplied in a smooth, continuous flow from a tank, there was no undue stretching of the bowel and no spasm. Almost all of the gas was absorbed from the colon in forty-five minutes, and, in accordance with the known physiologic activity of the colon, the gas in the proximal portion was absorbed first. A small amount of gas remained in the distal colon at two hours. This is believed to be due entirely to a voluntary effort to prevent its escape by rectum; in routine roentgenologic practice, it would have been expelled. The amount of gas remaining, however, does not appear to be much greater than the normal residual amount in the colon before the introduction of carbon dioxide (Figs. 1,A and 7,A).

The experiment was repeated on the same subject three weeks later, with air instead of carbon dioxide. The bowel was prepared as for the first examination. Since no apparatus was readily available for accurately metering the flow of air, an ordinary hand insufflator was used. It appears that a somewhat larger amount of air may have been introduced than of carbon dioxide, but this does not seem to have an important bearing on the results.

The accompanying illustrations show that practically no air was absorbed from

the colon in two hours; and the distended rectal ampulla shows how effectively escape by rectum was inhibited.

For the first hour, the subject complained of crampy pain generally distributed throughout the abdomen. After the first hour, the pain was localized to the right lower quadrant. This is explained by the excessive stretching of the cecum and ascending colon due to the fact that no gas was expelled by rectum and that spasm of the descending colon forced the gas into the proximal segment (Figs. 2,B and 7,B). At two hours, the subject was permitted to go to the toilet (no attempt was made to determine the time necessary for complete absorption of air from the colon, since this would have imposed undue discomfort). Pain in the right lower quadrant persisted for twelve hours.

#### SUMMARY

The rates of absorption of carbon dioxide and of air introduced into the colon for roentgenologic examination were compared. An amount of carbon dioxide sufficient to distend the entire colon was almost completely absorbed from the colon in forty-five minutes. An equal amount of air introduced into the same colon showed no significant absorption in two hours. In neither instance was the gas allowed to escape by rectum. The use of carbon dioxide was not attended by any discomfort. When air was used, there occurred, at first, generalized abdominal cramps. After two hours the pain became localized to the right lower quadrant and persisted for twelve hours. This study confirms the superiority of carbon dioxide over air for roentgenologic examination of the colon.

Massachusetts Memorial Hospitals  
750 Harrison Ave.  
Boston 18, Mass.

#### REFERENCE

1. LEVENE, G., AND KAUFMAN, S. A.: An Improved Technic for Double Contrast Examination of the Colon by the Use of Compressed Carbon Dioxide. *Radiology* 68: 83-85, January 1957.

*(Pro le sumario in interlingua, vider pagina 577)*

# Gallbladder Visualization Following the Use of 70 Per Cent Sodium Acetrizoate (Urokon Sodium) for Intravenous Pyelography<sup>1</sup>

IVAN M. WOOLLEY, M.D., LOWELL W. KEIZUR, M.D.,<sup>2</sup> and GUENTHER MAYER-HARNISCH, M.D.

IN THE COURSE of a kidney examination of a 6-year-old girl, a retrograde pyelographic study was done two hours after the

Since we had not previously encountered this phenomenon, and were not familiar with the work of Porporis (1) or Orloff (2),

OBSERVATIONS ON 25 PATIENTS RECEIVING 70 PER CENT UROKON SODIUM FOR PYELOGRAPHY

Case	Sex and Age	Clinical Observations	Classification
1	F6	Clinical impression: Pyelitis and cystitis. IVP: Normal. Retrograde pyelogram two hours after IVP showed gallbladder shadow.	***
2	F38	Clinical impression: Suspected kidney stone. IVP: Normal.	**
3	M74	Clinical impression: Carcinoma of bladder. IVP: Normal on right; no visualization of left kidney. Extension of carcinoma from bladder to ureter found later.	***
4	F5	Clinical impression: Acute cystitis and pyelitis. IVP: Normal.	***
5	M42	Clinical impression: Suspected urinary calculus. IVP: Early left hydronephrosis.	*
6	F60	Clinical impression: Acute pyelitis and cystitis. IVP: Normal.	*
7	M39	Clinical impression: Acute pyelonephritis. IVP: Possible parenchymal disease of left kidney.	*
8	F41	Clinical impression: Acute cholecystitis. IVP: Normal. Operation revealed involvement of gallbladder, with adhesions. Pathologic diagnosis: Chronic cholecystitis. Marked constriction of cystic duct.	***
9	F7	Clinical impression: Cystitis and pyelitis. IVP: Normal.	***
10	M63	Clinical impression: Mass in right upper quadrant. IVP: Distortion of right kidney structures compatible with tumor. Nephrectomy: Adenocarcinoma.	***
11	M24	Clinical impression: Acute appendicitis. IVP: Normal.	*
12	M7	Clinical impression: Acute mesenteric adenitis. IVP: Normal.	*
13	M42	Clinical impression: Hypertensive vascular disease; tension, headaches. IVP: Normal.	*
14	M69	Clinical impression: Benign prostatic hypertrophy. IVP: Normal.	**
15	F69	Clinical impression: Suspected polycystic kidney. IVP: Structural changes, left kidney.	*
16	M3	Clinical impression: Abdominal pain undiagnosed. IVP: Normal.	*
17	M72	Clinical impression: Benign prostatic hypertrophy. IVP: Normal.	*
18	M13	Clinical impression: Contusion of left kidney. Hematuria. IVP: Normal. Calyces visible after two hours.	*
19	F48	No clinical diagnosis. IVP: Normal. Visible calyces in two hours.	*
20	F63	Clinical impression: Osteoarthritis of spine. Chronic duodenal ulcer. IVP: Normal.	**
21	F38	Clinical impression: Colitis. IVP: Normal.	*
22	F27	Clinical impression: Chronic hepatitis. IVP: Normal.	*
23	F73	Clinical impression: Chronic cholecystitis. IVP: Normal.	*
24	F20	Clinical impression: Suspected blocked ureter. Pregnancy 25 weeks. IVP: Delayed excretion, right kidney.	*
25	M72	Clinical impression: Pyelonephritis. IVP: Right hydronephrosis and hydro-ureter. Incomplete visualization left kidney. Final diagnosis: Carcinoma of bladder.	*

intravenous injection of 12.5 c.c. of Urokon Sodium (70 per cent). The two-hour time interval was purely incidental. The scout film was negative, but the first pyelogram of the series showed a well defined gallbladder shadow, partially superimposed upon the shadow of the opacified right kidney.

we set up a preliminary survey to determine, if possible, the frequency with which such findings might occur. The next 24 consecutive patients receiving intravenous Urokon Sodium (70 per cent) for kidney studies were returned for gallbladder films two hours after receiving the contrast medium. Their ages varied from three

<sup>1</sup> From the Department of Radiology, Emanuel Hospital, Portland, Ore. Accepted for publication in April 1957.

<sup>2</sup> From the Department of Urology.

to seventy-four years. No attempt at selection of cases was made.

Gallbladder shadows were classified on the basis of density as follows: \* barely visible, \*\* easily visible, \*\*\* clearly visible. In 12 of the 25 patients (including the original patient) shadows were observed that could be classified in one of these three groups. Five were in the clearly visible group. No attempt was made to carry out any specific study of the patients. The sole data obtained in this series thus far are shown in the accompanying tabulation.

Serial studies were not done. These might show a higher percentage of gallbladder visualization. Our sole purpose was to determine the frequency with which this phenomenon might be encountered two hours after intravenous administration of Urokon Sodium 70 per cent for excretory urography.

#### SUMMARY

Twenty-five consecutive patients undergoing excretory urographic studies were examined radiographically two hours after having received standard doses of Urokon Sodium 70 per cent. Twelve of the twenty-five showed some degree of opacification of the gallbladder. In 5 of the 12, the gallbladder shadow was graded as clearly visible.

Emanuel Hospital  
2801 N. Gantenbein Ave.  
Portland 12, Ore.

#### REFERENCES

1. PORPORIS, A. A., ZINK, O. C., WILSON, H. M., BARRY, C. N., BOYCE, R., AND ROSE, D. K.: Routine Clinical Experiences Using Urokon Sodium 70% in Intravenous Urography. *Radiology* 60: 675-685, May 1953.
2. ORLOFF, T. L.: Intravenous Cholecystography with a New Medium: Experience with Sodium Acetizoate (Urokon Sodium) Seventy Per Cent. *Arch. Surg.* 71: 620-622, October 1955.

#### SUMMARIO IN INTERLINGUA

##### Visualisation del Vesica Biliari Post le Uso de 70 Pro Cento de Acetrizoato de Natrium (Urokon a Natrium) Pro Pyelographia Intravenose

Vinti-cinque patientes consecutive, de etates de inter tres e septanta-quattro annos, subjicite a studios urographic excretori, esseva examine radiographicamente duo horas post recipere doses standard de Urokon

a natrium de 70 pro cento. Dece-duo del 25 monstrava un certe grado de opacification del vesica biliari. In 5 del 12, le umbra del vesica biliari esseva gradate le plus clarmente possibile.

#### SUMMARIO IN INTERLINGUA

##### Rapiditate del Absorption Venose de Bioxydo de Carbon e de Aere in le Examine a Duple Contrasto del Colon

(Pagina 571)

Le rapiditate del absorption de bioxydo de carbon e de aere introduce in le colon pro objectivos del examine roentgenologic esseva comparate. Un quantitate de bioxydo de carbon sufficiente pro distender le integre colon esseva absorbite quasi completamente in quaranta-cinque minutas. Le mesme quantitate de aere introduce in le colon del mesme individuo monstrava nulle absorption significative in duo horas. In ambe casos attention esseva prestate

a que le gas non escappava via le recto. Le uso de bioxydo de carbon non esseva accompagnate per ulle disconforto. Quando aere esseva usate, il occurreva al initio generalisate crampos abdominal. Post duo horas le dolor se localisava in le quadrante dextero-inferior e persisteva durante dece-duo horas. Iste studio confirma le superioritate de bioxydo de carbon super aere pro objectivos del examine roentgenologic del colon.

# Practical Application of the 0.3-mm. Focal Spot

## A Special Cassette Holder<sup>1</sup>

OLLIE J. SPARKS, R.T., and ROBERT D. SHEPARD, M.D.

Lexington, Ky.

FOLLOWING THE acquisition of a tube with a 0.3-mm. focal spot, a study was instituted to determine the progression of healing in femoral neck fractures with "macro" views. During the initial phase of the research, difficulty was experienced in obtaining an entirely satisfactory lateral view since the cassette for this projection was held at the desired angle and distance by sandbags alone. It was quickly realized that this crude method would never suffice, since it was practically impossible to be certain that the film was held perpendicular to the central beam.

The unsharpness associated with the use of double-emulsion film is well known. It is also common knowledge that this inherent unsharpness is further aggravated by angulation of the x-ray focus with respect to the plane of the film. Also, the increased object-film distance in direct enlargement procedures obviates the necessity of having the plane of the film angled with respect to the central ray, since the film can be rotated so as to intercept the ray in the perpendicular plane.

To overcome this problem and to assure precise centering of film and focal spot, a special detachable cassette holder was designed by one of the authors (O.J.S.). This device, shown in use in Figure 1, is constructed of light aluminum tubing and consists of three parts: (1) a vise-type clamp (A, Fig. 2) permanently attached to the tube housing between the housing and cone track; (2) a short horizontal frame with a second vise-type clamp at its outer end (B, Fig. 2); (3) a vertical frame (C, Fig. 2), held by this clamp, with the cassette holder at the lower end. These three parts, when assembled, are in relatively the same position as shown in Figure



Fig. 1. Relation of tube, patient, and cassette holder.

2. The design is such that the film is always centered to the central ray regardless of tube angulation. There is a maximal adjustable length of 16 inches, permitting a variation of target-film distance from 44 to 60 inches. When in use, the tube is angled to the desired degree and the cassette holder is then stabilized by resting its weight on an aluminum rod (Fig. 1). This rod slides in a pivot-pin arrangement that can be manually tightened at the desired height.

Figure 1 illustrates the cassette holder in relation to tube angulation and the patient. The table used in this particular technic is an old, war-surplus, portable

<sup>1</sup> Accepted for publication in April 1957.



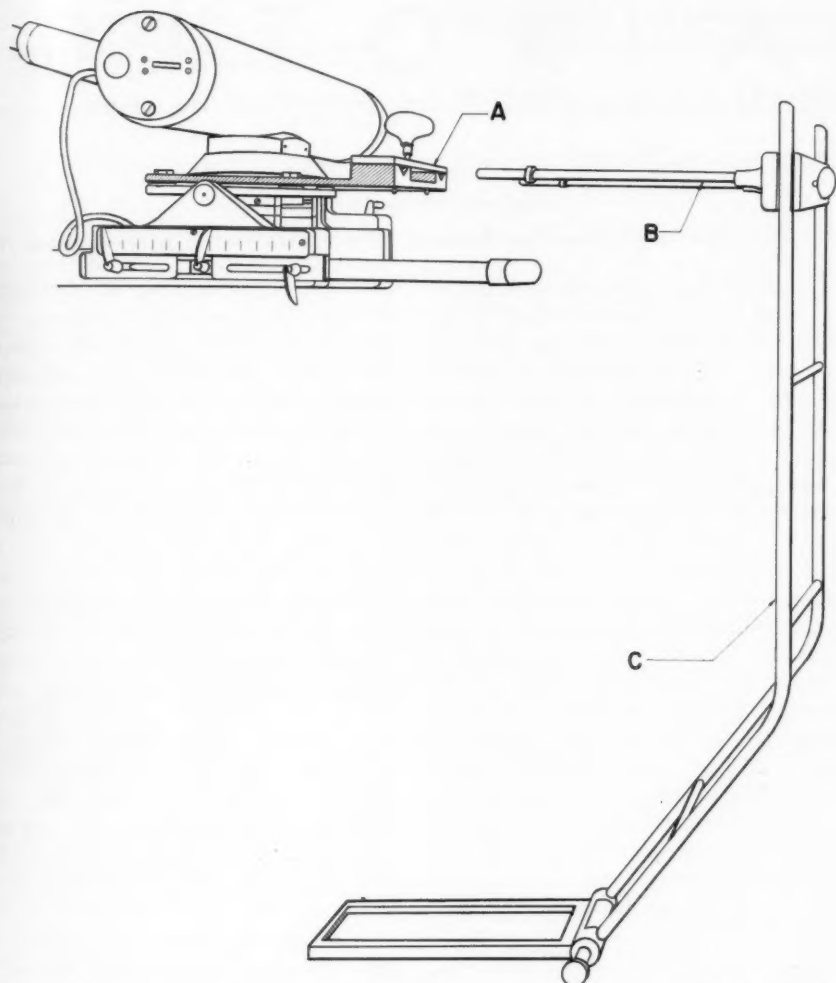


Fig. 2. Detail drawing of component parts of special cassette holder for use with tube having a 0.3-mm focal spot.

unit with a Micarta top. The legs have been immobilized by an angle-iron, rectangular brace to provide improved structural strength, and rubber casters allow mobility of the unit. Attached to the legs are threaded bolts with a crank to lower them to the floor for the purpose of anchoring the table.

A more practical application of this device was found in the examination of seriously injured patients; that is, persons who had sustained serious vertebral in-

juries that would not allow movement other than in a horizontal plane. With this special cassette holder, it is now possible to examine a portion of the vertebral column in all planes while the patient remains in either a supine or prone position. Recently, the use of a "Transaver" cart has eliminated movement to and from the table.

Involuntary motion, however, still creates a problem. This we hope to eliminate with the use of Machlett's 150-

kvp water-cooled tube,<sup>2</sup> which will allow a marked decrease in exposure time.

<sup>2</sup> Machlett has been generous in loaning us such a tube with which to continue this study.

## REFERENCE

SPARKS, O. J.: Optimum Projections with 0.3 mm Focus. *X-Ray Technician* **28**: 321-327, March 1957

Good Samaritan Hospital  
Lexington, Ky.

## SUMMARIO IN INTERLINGUA

**Application Practic del Spot Focal de 0,3 mm: Un Porta-Cassetta Special**

In un serie de studios, in que un tubo con un spot focal de 0,3 mm esseva usate pro determinar le progresso del sanation de fracturas del cervice femoral, il esseva trovate que le methodo de usar saccos de arena pro fixar le position del cassetta in prender le vista lateral esseva troppo crude e non produceva resultatos accurate. Per consequente un porta-cassetta special

esseva construite que se distingue per le facto que le pellicula es semper centrate relative al radio central, sin reguardo al angulation del tubo. Le detalios del construction es monstrate in un schizzo.

Iste dispositivo ha essite usate in le practica in examinar patientes con serie lesiones vertebral que permette nulle movimento excepte in le plano horizontal



# EDITORIAL

## The Care of Patients with Bronchial Cancer

Primary bronchial carcinoma is a pleomorphic disease with predominantly unfavorable characteristics. While it may remain localized for several years, it tends more frequently to relatively early generalization. Karnofsky (3) would divide the clinical types of bronchial cancer into five groups, according to the following general patterns: (a) localized disease; (b) early generalized disease; (c) cerebral metastatic disease; (d) osseous metastatic disease; (e) hepatic metastatic disease.

Of 100 consecutive unselected patients in whom bronchial carcinoma is diagnosed, it is currently estimated that about one-half are surgically incurable at the time of diagnosis and about one-half are eligible for surgical exploration. In the latter group, about one-half prove to have non-resectable growths, while the other (or 25 cases) have resectable disease. Of the 25 patients undergoing resection, between 1 and 5 are apt to die as a result of surgery, about 16 will die of their disease within the ensuing five years, and between 4 and 8 will survive five years. If one is fortunate in securing the latter figure, one can correctly claim a 32 per cent five year "cure rate" of the resected group. On the other hand, this represents at best only 8 patients out of the original 100. This is a measure of the problem.

Lesions which are peripheral and diagnosed while still "a solitary nodule" naturally have a better prognosis than those which are central and are recognized only when atelectasis or adenopathy is already present. Well differentiated squamous-cell tumors tend to have a better prognosis than poorly differentiated tumors.

As clinicians, we are faced with the fact that about 90 per cent of bronchial can-

cers are still not curable by the optimum method of treatment—*surgical excision* of the disease while still localized in the lung. This preponderant group, even though incurable, deserves careful and individualized treatment.

The first step in planning treatment is to attempt to determine the anatomic extent of disease present, that is, to stage bronchial carcinoma in a manner somewhat similar to that used for cancer in other sites. Such staging must, however, be based on more than the clinical or radiological evidence alone. It requires knowledge of the combined clinical, radiological, bronchoscopic, and microscopic findings. Details concerning this staging have been reported elsewhere (2). It covers both bronchial and bronchiolar carcinoma, it allows for carcinoma *in situ* (Stage 0) and for carcinomas unclassifiable because of bizarre histologic type of spread (Stage U). In approximately 100 consecutive cases of bronchial cancer so studied, the staging was as follows:

Stage 0.....	2%
Stage I.....	14%
Stage II.....	18%
Stage III.....	29%
Stage IV.....	33%
Stage U.....	3%

The radiotherapist is usually consulted regarding the treatment of patients already in Stage III or IV. For this reason, the results of radiotherapy cannot be compared with those of surgical therapy, since the basic group of patients treated is quite different.

Radiotherapy may be radical or palliative, depending upon the stage of the disease, the general status of the patient, and the clinical problem produced by the tumor. If the process is still relatively

localized, attempts at curative radiotherapy may be indicated. Radical radiotherapy requires the delivery of a tumor dose of between 4,000 and 6,000 rads throughout the involved tissue in a period of four to six weeks. Palliative radiotherapy may be effected with doses at various levels, usually in the neighborhood of 3,000 rads in four weeks time. Depending on the type of ionizing beam available, these doses may be delivered with smaller or larger beams, with moving or fixed fields, with grids, etc. Judging by reports in the literature, as well as by our own experience in a city in which megavoltage has been utilized for almost three decades, the results obtainable with orthovoltage (200 kv) are not significantly different from those obtainable with 2,000 kv or cobalt-beam units. We have reported squamous-cell bronchial tumors locally "sterilized" with doses as small as 3,500 rads delivered in four weeks (as proved by subsequent careful microscopic studies); conversely, we have seen persistent local tumor following tumor doses as high as 6,500 rads in four weeks (1). By gradation of dosage, side effects may be minimized irrespective of primary beam quality.

The median survival time of patients with untreated bronchial cancer is approximately three months from the time of completion of diagnosis. The median survival time of patients treated with palliative radiotherapy (mostly patients in Stages III and IV) is approximately six months from time of treatment. Radiotherapy, therefore, does not significantly increase the survival time of most patients. However, when properly utilized, it does increase the comfort of the patient's surviving days. While it is always difficult to measure symptomatic response, the following represents our own observations with radiotherapeutic palliation of bronchial cancer:

Cough: Moderate to marked relief in 60 per cent of cases.

Chest pain: Moderate to marked relief in 60 per cent of cases.

Hemoptysis: Significant reduction in 75 per cent of cases.

Superior mediastinal obstruction: Significant relief in 50 per cent of cases.

For pleural effusion, it has been our experience that wide-field roentgen irradiation is more effective than intrapleural radioactive gold or mustard, especially as an initial weapon.

On a sanguine note, one should also add that radical radiotherapy is occasionally associated with clinical cure. Several radiologists have reported small groups of patients who have remained clinically well for five or more years following radical irradiation. The possibility of increasing the number of such cases by the use of tumor-sensitizing drugs or carcinocidal-augmenting procedures is under study. There seems no doubt that the combination of adequate doses of nitrogen mustard and its prototypes improves the outlook of some patients with superior mediastinal obstruction. Intensive efforts have been made to augment the effect of radiotherapy by the use of preparations such as synthetic vitamin K, actinomycin D, and other precautions. Since the biology of bronchial carcinomas varies considerably from one patient to another, the measurement of significant effect with these auxiliary agents is extremely difficult.

Finally, it should be noted that pathologists are encountering an increasing number of cases in which the diagnosis of frank malignancy is not as simple as one might wish. There are, for example, an increasing number of case reports of bronchial adenomas of the carcinoid type, which on preliminary study by the less experienced were called anaplastic bronchial carcinoma. Many of these tumors pursue a benign course, and some undoubtedly account for apparent cures by surgical or radiotherapeutic means.

In summary, therefore, it may be re-emphasized that roentgen therapy has a useful place in the palliation of bronchial cancer. In using orthovoltage therapy, it is important that adequately large

fields be employed and that the centering of beam be checked by both fluoroscopic and radiographic means. Careful gradation of dosage, with exhibition of nausea-diminishing drugs (especially when liver irradiation cannot be avoided), will permit completion of planned courses of therapy within a reasonable number of days. Properly employed radiation therapy is usually less drastic than chemotherapy or palliative surgery. It is widely available today, and is indicated for the care of most patients with the disease. With such treatment, patients with bronchial carcinoma are usually made more comfortable for part of the period of survival; they are given hope and the knowledge that something definite is being done for their condition.

Experiences of others with careful programs of radiotherapy and chemotherapy are outlined in the symposium published in this issue of *RADIOLOGY*. They are encouraging, but at the same time remind us of the fact that the real solution to this difficult problem must lie in the realm of prevention, and not in treatment—either radical or palliative.

L. H. GARLAND, M.B.

#### REFERENCES

1. GARLAND, L. H., AND SISSON, M. A.: The Results of Radiotherapy of Bronchial Cancer. *Radiology* 67: 48-62, July 1956.
2. GARLAND, L. H.: The Roentgen Diagnosis of Lung Cancer. Proceedings of the Third National Cancer Conference, Detroit, 1956. Philadelphia, J. B. Lippincott Co., 1957, pp. 521-525.
3. KARNOFSKY, D. A., GOLBEY, R. B., AND POOL, J. L.: Preliminary Studies on the Natural History of Lung Cancer. *Radiology* 69: 477-488, October 1957.





## ANNOUNCEMENTS AND BOOK REVIEWS

### EXAMINATIONS AMERICAN BOARD OF RADIOLOGY

The Spring 1958 examinations of the American Board of Radiology will be held at the Palmer House, Chicago, Ill., May 19-23, inclusive. The deadline for filing applications is Jan. 1, 1958. Correspondence should be addressed to the American Board of Radiology, Kahler Building, Rochester, Minn.

### ATLANTA RADIOLOGICAL SOCIETY

The Atlanta Radiological Society, at a recent meeting, elected the following officers: President, Ted Leigh, M.D.; Vice-President, John Ellis, M.D.; Secretary-Treasurer, J. Luther Clements, Jr., M.D., 35 Linden Ave., N. E., Atlanta 8.

### GREATER CINCINNATI RADIOLOGICAL SOCIETY

At a recent meeting of the Greater Cincinnati Radiological Society officers were elected for the coming year as follows: Morris M. Garrett, M.D., President; Roland Wintzinger, M.D., Vice-President; Warner A. Peck, Jr., M.D., 441 Vine St., Cincinnati 2, Secretary-Treasurer.

### RADIOLOGICAL SECTION ILLINOIS STATE MEDICAL SOCIETY

Officers of the Section on Radiology of the Illinois State Medical Society for the current year are: Chairman, Theodor J. Lang, M.D., Rockford; Secretary, William Meszaros, M.D., 1825 W. Harrison St., Chicago.

### LOS ANGELES RADIOLOGICAL SOCIETY

At a recent meeting of the Los Angeles Radiological Society, the following officers were elected: President, Richard A. Kredel, M.D.; Vice-President, Lewis J. Peha, M.D.; Secretary, Putnam C. Kennedy, M. D., 540 N. Central Ave., Glendale 3; Treasurer, Robert E. Rickenberg, M.D.; Member of the Executive Committee (three-year term), Hubert J. Prichard, M.D.

### OAK RIDGE INSTITUTE OF NUCLEAR STUDIES SPECIAL TRAINING DIVISION

The Special Training Division of the Oak Ridge Institute of Nuclear Studies has announced the following 1958 schedule of four-week courses in the basic technics of using radioisotopes: January 6-31; February 3-28; May 19-June 13; June 16-

July 11; August 11-September 5; September 8-October 3. These courses consist of laboratory work, lectures on laboratory experiments, general background lectures, and special-topic seminars, with the greater portion of the time devoted to laboratory studies.

Further information may be obtained from Dr. Ralph T. Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

### JAMES PICKER FOUNDATION AWARDS IN RADIOLOGICAL RESEARCH

The James Picker Foundation announces two awards in the field of radiological research in addition to those previously made public (see RADIOLOGY, August 1957). A research grant has been made to the University of Saskatchewan, Saskatoon, Canada, to permit continuation for a third year of Dr. Sidney P. Traub's studies on x-ray changes produced by increased pressure within the skull. A grant has also been awarded to Dr. Hans Ludin of the Department of Radiology, New York Hospital, New York, to continue his study, begun in 1956, of the use of special technics to visualize the pancreas on x-ray examination.

### AMERICAN CANCER SOCIETY

As a part of its Annual Meeting for 1957, the American Cancer Society is sponsoring a Scientific Session devoted to Cancer of the Head and Neck. This will be conducted Oct. 28-29 in the Grand Ballroom of the Park Sheraton Hotel, New York City.

## Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ANGIOCARDIOGRAPHIC INTERPRETATION IN CONGENITAL HEART DISEASE. By HERBERT L. ABRAMS, M.D., Assistant Professor of Radiology, Stanford University School of Medicine, San Francisco, California, and HENRY S. KAPLAN, M.D., Professor of Radiology, Stanford University School of Medicine. Publication Number 279, American Lecture Series, a monograph in the Bannerstone Division of American Lectures in Pediatrics. A volume of 234 pages, with 163 figures. Published by Charles C Thomas, Springfield, Ill., 1956. Price \$11.75.

**PNEUMOENCEPHALOGRAPHY.** By E. GRAEME ROBERTSON, M.D. (Melb.), F.R.C.P., F.R.A.C.P., Honorary Neurologist, Royal Melbourne Hospital, Honorary Neurologist, Royal Children's Hospital, Honorary Consultant Neurologist, Royal Women's Hospital, Melbourne, Australia, Honorary Consultant Neurologist, Victorian Eye and Ear Hospital, Consultant Neurologist to the Ministry of Health, Tasmania. A volume of 482 pages, with 209 figures. Published by Charles C Thomas, Springfield, Ill., 1957. Price \$14.50.

**BRONCHIECTASIS: RADIOLOGICAL DIAGNOSIS AND PROGNOSIS AFTER OPERATIVE TREATMENT.** Acta radiologica Supplement 143. By CARL EINER GUDBJERG. A monograph of 118 pages, with 45 figures and 8 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 25.—

**EXPERIMENTAL STUDIES ON THE DISAPPEARANCE OF RADIOSODIUM IONS FROM LOCAL DEPOSITS IN THE CAVITY AND IN THE WALL OF THE VAGINA OF THE RAT.** Acta radiologica Supplement 144. By BJÖRN WESTIN. A monograph of 88 pages, with 42 figures, and 19 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 30.—

**DEMOGRAPHIC STUDIES ON CARCINOMA OF THE UTERINE CERVIX IN SWEDEN. PART I.** Acta radiologica Supplement 145. By O. G. A. BERGGREN. A monograph of 148 pages, with 40 diagrams, 93 tables, and 4 maps. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 30.—

**THE PROXIMAL END OF THE FEMUR. INVESTIGATIONS WITH SPECIAL REFERENCE TO THE ETIOLOGY OF FEMORAL NECK FRACTURES. ANATOMICAL STUDIES, ROENTGEN PROJECTIONS, THEORETICAL STRESS CALCULATIONS, EXPERIMENTAL PRODUCTION OF FRACTURES.** Acta radiologica Supplement 146. By STIG BACKMAN. A monograph of 166 pages, with 70 figures and many tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 35.—

**CHANGES IN LIVER CELL ELEMENTS DURING STIMULATED PROTEIN SYNTHESIS. A CYTOCHEMICAL STUDY.** Acta radiologica Supplement 147. By G. F. BAHR. A monograph of 112 pages, with 59 figures and 4 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 25.—

**QUANTITATIVE ROENTGENOLOGIC STUDIES ON CHANGES IN MINERAL CONTENT OF BONE IN VIVO.** Acta radiologica Supplement 148. By KARL-ÅKE OMNELL. A monograph of 86 pages,

with 12 figures, 16 diagrams, and 11 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 25.—

**SYSTEMIC RETICULOENDOTHELIAL GRANULOMA.** Acta radiologica Supplement 149. By PER WESTLING, KURT SUNDBERG, AND GUNNAR SÖDERBERG. A monograph of 66 pages, with 32 figures and 1 table. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 25.—

**MAJOR ACTIVITIES IN THE ATOMIC ENERGY PROGRAMS, JANUARY-JUNE 1957.** United States Atomic Energy Commission. A monograph of 258 pages, with figures and tables. Published by the Superintendent of Documents, Government Printing Office, Washington, D. C., 1957. Price 75 cents.

**INDIAN JOURNAL OF RADIOLOGY: SOUVENIR NUMBER TO COMMEMORATE THE DIAMOND JUBILEE OF THE DISCOVERY OF X-RAYS BY DR. W. C. ROENTGEN.** A volume of 700 pages of original papers on Radiodiagnosis, Radiotherapy, Radiophysics, and Radiobiology, by eminent radiologists and radiophysicists from the United Kingdom, Continental Europe, and America. Available from the General Secretary, Indian Radiological Society, 1, Barakhamba Road, New Delhi, 1, India. Price \$5.00.

**ROTATION RADIOGRAPHY.** By SHINJI TAKAHASHI, M.D., Professor of Radiology, School of Medicine, University of Nagoya, Head of the Department of Radiology, Hospital of the University of Nagoya, in Japan, and Professor of Radiology, School of Medicine, University of Hirosaki, Head of the Department of Radiology, Hospital of the University of Hirosaki, in Japan. A volume of 164 pages, with 118 figures and 19 tables. Published by the Japan Society for the Promotion of Science. Sales agent: Maruzen Co., Ltd., Nihonbashi, Tokyo, Japan, 1957.

**ANNUAL EPIDEMIOLOGICAL AND VITAL STATISTICS 1954. PART I: VITAL STATISTICS AND CAUSES OF DEATH. PART II: CASES OF AND DEATHS FROM NOTIFIABLE DISEASES. PART III: STATISTICS OF HEALTH PERSONNEL, HOSPITAL ESTABLISHMENTS AND VACCINATIONS.** [In English and French.] A volume of 618 pages. Published by World Health Organization, Geneva, Switzerland, 1957. Distributed in the United States by the Columbia University Press, International Documents Service, 2960 Broadway, New York 27, N. Y. Price \$10.

**FORTSCHRITTE DER KIEFER- UND GESICHTS-CHIRURGIE: EIN JAHRBUCH. BAND III.** Edited by Prof. Dr. Dr. KARL SCHUCHARDT, Direktor der

Klinik und Poliklinik für Zahn-, Mund- und Kieferkrankheiten der Universität Hamburg und der Nordwestdeutschen Kieferklinik. A volume of 360 pages, with 391 figures. Published by Georg Thieme Verlag, Stuttgart, Germany, 1957. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York, N. Y. Price DM 96.—(\$22.85.)

## Book Reviews

**CLINICAL USE OF RADIOISOTOPES.** By WILLIAM H. BEIERWALTES, M.D., Associate Professor of Internal Medicine and Coordinator, Clinical Radioisotope Unit, University Hospital, Ann Arbor; PHILIP C. JOHNSON, M.D., Assistant Professor of Internal Medicine and Chief, Radioisotope Unit, Veterans Administration Hospital, University of Oklahoma Medical School, Oklahoma City; ARTHUR J. SOLARI, B.S., M.S. (Physics), Instructor in Radiation Physics, Department of Radiology, Radiation Physicist for Clinical Radioisotope Unit and Kresge Research Isotope Unit, University Hospital, Ann Arbor. A volume of 456 pages, with 126 figures. Published by W. B. Saunders Co., Philadelphia & London, 1957. Price \$11.50.

This useful book was prepared as a textbook for the course in clinical application of radioisotopes at the University of Michigan. It covers the employment of radioisotopes both as diagnostic tools and as therapeutic agents. As is usual in a book of this sort, the discussion includes only those radioisotopes that are administered in solution or colloidal suspension; the discrete sources such as Au<sup>198</sup> seeds, Ta<sup>182</sup> wire, Sr<sup>90</sup> B applicators, etc., are not considered.

By far the greatest amount of space is devoted to I<sup>131</sup> and its use in thyroid disorders. A chapter on thyroid physiology, as it is known at present, is followed by one on the use of the isotope in the study of thyroid function, both in uptake studies and as a measure of circulating thyroid hormone. I<sup>131</sup> as a therapeutic agent in benign thyroid disorders, its place in the diagnosis and treatment of thyroid cancer, and its other clinical uses, are accorded separate chapters. Discussions of P<sup>32</sup>, Au<sup>198</sup>, and a wide variety of less commonly known isotopes are given. In addition to the discussions of the radioactive materials themselves, there are chapters devoted to the biologic effects of radiation, health physics, instrumentation, and the administrative details of obtaining certification and setting up a radioisotope unit.

The book generally is an excellent review of current practice in the use of radioisotopes in medicine and is recommended to all students of the subject. An ample bibliography is appended to each chapter, and the presentation of indications and contraindications for the various procedures is clear and con-

cise. Appendixes giving additional reference data and a detailed index complete the volume.

**RADIOLOGICAL DIAGNOSIS OF BRONCHIECTASIS.** By CARL BENIGNUS ARTHUR JULIEN PUIJLAERT. A thesis leading to the degree of Doctor of Medicine in the University of Leiden. English translation by L. Stein, M.D. A monograph of 46 pages, with 44 roentgenograms. Published by H. E. Stenfort Kroese, N. V., Leiden, Holland, 1957.

In this thesis, which has been translated from the Dutch, the author discusses the radiologic examination of patients with bronchiectasis as based on material seen at the University Hospital of Leiden. No attempt at statistical analysis is made, the author preferring to survey the subject under the following four aspects: straight radiography and fluoroscopy in the diagnosis of bronchiectasis, the significance of planigraphy, the technic of bronchography, and clinical symptoms leading to the employment of bronchography.

A distinction is made on plain films between direct visible changes in the bronchial tree itself and indirect findings resulting from the bronchiectatic process. The bronchiectatic dilatations are demonstrable by (1) their greater air content in comparison with adjacent normal structures; (2) filling with mucopurulent exudate, (3) thickening of the bronchial wall, and (4) the air content in atelectasis or an infiltrate. The indirect findings, which are more important, include (1) atelectasis of lobes or segments recognized by lack of air and displacement of neighboring structures and (2) complementary emphysema in adjacent segments and/or in the bronchiectatic area itself.

Dionosil is considered the contrast agent of choice, as it is water-soluble and relatively non-irritant, and is not displaced too far peripherally, so that alveolar filling is practically eliminated. One can thus spend as much time as is necessary waiting for adequate filling. The medium is introduced intermittently by a nasal intratracheal catheter. A rather high kilovoltage is used for the roentgenograms, which are taken in deep inspiration in order to stretch the branches as much as possible.

Included in this monograph is a group of illustrations from 21 cases.

**MALADIES DES VEINES: DIAGNOSTIC ET TRAITEMENT.** By CLAUDE OLIVIER, Agrégé de la Faculté de Médecine de Paris, Chirurgien des Hôpitaux. Preface by Professor H. Mondor. A volume of 600 pages, with 342 figures and 1 colored plate. Published by Masson & Cie, Editeurs, 120, Boulevard Saint-Germain, Paris 6<sup>e</sup>, France, 1957. Price 6,700 francs (paper bound); 7,400 francs (cloth).

This large monograph is a very comprehensive survey of the diagnosis and treatment of diseases of

the veins, based on 2,500 clinical cases, 1,500 phlebographic studies, and several hundred operative and other therapeutic procedures. Because roentgenographic methods are used in studying the morphology and function of veins, the work contains much material of interest to the diagnostic roentgenologist.

The text is divided into nine large sections: the diagnosis of recent venous thromboses; the treatment of recent venous thromboses; pulmonary emboli; prophylaxis of thrombo-embolic disease; essential varices (without known cause); complications of essential varices; varices symptomatic of vascular malformations; old venous thromboses;

phlebography. Extensive periodical references are given after each chapter and frequently following subdivisions of the chapters. A bibliography of 118 monographs and supplements is furnished at the end of the text.

The reader would have to consult literally several hundred references to find all the material covered in this volume. It is probably the most comprehensive single work available in its field. Each chapter is illustrated with superb reproductions of roentgenograms.

The reviewer enthusiastically recommends this monograph to anyone interested in the diagnosis or treatment of diseases of veins.



## RADIOLOGICAL SOCIETY OF NORTH AMERICA

### FORTY-THIRD ANNUAL MEETING: COMMERCIAL EXHIBITS

The following list of Commercial Exhibits is but an indication of the wealth of material that will be presented at the Forty-third Annual Meeting of the Radiological Society of North America. It has been prepared by the Commercial Exhibits Committee (Chairman, Dr. John H. Gilmore) as a guide for those in attendance at the meeting.

**ABBOTT LABORATORIES, INC.,** North Chicago, Ill. (Booth 108): The Abbott Laboratories will present a complete display of the radiopharmaceuticals required for a clinical isotope program in the hospital or clinic. Radioiodine will be shown in various liquid forms and in capsules which avoid the need for special handling facilities. Also illustrated will be Iodo Triolein for fat absorption studies, Rachromate for studying cell survival, RISA for blood volume measurements, and I-131 Rose Bengal for liver function determinations. Cobalt-60 sources for needles and applicators will also be featured.

**ANSCO DIVISION, GENERAL ANILINE & FILM CORPORATION,** Binghamton, N. Y. (Booths 16 and 17).

**ATOMIC ENERGY OF CANADA, LTD.,** Ottawa, Canada (Booths 26 and 27): On display will be models of the most recent cobalt-60 teletherapy equipment, including the latest addition, the Eldorado "G," a unit featuring maximum flexibility with a very high roentgen output.

**THE AUTOMATIC SERIOGRAPH CORPORATION,** College Park, Md. (Booth 107), will exhibit the Sanchez-Perez Universal Model 110 Automatic Serigraph. The Serigraph, utilizing standard 11 x 14-inch cut film, takes 12 individual cassettes, each with its own set of intensifying screens. Since the machine operates on the cassette-changing principle, the same excellent detail can be obtained as is possible with standard single cassette technic. The unit has an infinitely variable interval speed and will take up to 2 pictures per second.

**BARNES-HIND BARIUM PRODUCTS, INC.,** Sunnydale, Calif. (Booth 37).

**BAR-RAY Products, Inc.,** Brooklyn, N. Y. (Booths 105 and 106), will feature the new "Royal" line of processing tanks. These are faced with formica and incorporate the very latest in high speed x-ray-film-processing facilities. The formica exte-

riors prevent rust and discoloration, and are available in a wide selection of colors to match any dark-room decor. Bar-Ray's new formica-faced floor screen, also shown, is 1.5 mm. lead-lined throughout, has a rich mahogany finish and a big glass observation window. It rolls on large ball-bearing wheels.

**BELL-CRAIG, INC.,** New York, N. Y. (Booth 13).

**BROWN-FORMAN INDUSTRIES,** Louisville, Ky. (Booths 88 and 89).

**BUCK X-GRAPH COMPANY,** St. Louis, Mo. (Booth 83).

**CARR CORPORATION,** Culver City, Calif. (Booths 24 and 25), will exhibit three types of processing equipment: one, of new design, is quite a drastic change from the present apparatus; the second is a new automatic model; and the third, an assortment of the different styles of dryers now available.

**COCA COLA COMPANY,** Atlanta Ga. (Booth 7).

**CONTINENTAL X-RAY CORPORATION** (Booths 114 and 115): Continental X-Ray Corporation's line of mobile x-ray equipment will be represented by a 300 ma. at 100-kvp full-wave rectified machine. In addition to the increased power, this mobile unit, low enough to pass through any standard door, will feature a 12-inch geared height extension, operable on either "hand crank" or "counterbalanced" tube stands. This device makes possible focal-spot-to-floor distances of 74 inches and 78 inches on counterbalanced and hand-crank tube stands respectively, providing ample height for a 30-inch distance over urological or operating tables.

**DICK X-RAY COMPANY,** St. Louis, Mo. (Office 403): The "Commando" is the new ceiling-suspended cobalt-60 teletherapy unit utilizing a 1-cm. source of 225 curies at a source-skin distance of 25 cm. This results in an economical and effective balance between roentgen output, percentage depth dose, penumbra, and surface ionization ratio. Beam-directional facilities include counterbalanced angulation with magnetic locks and a variable speed motor drive for elevation.

**DUNLEE CORPORATION,** Chicago, Ill. (Booths 91 and 92), will have on display thoriated tungsten filament valve tubes with and without resistors; pure tungsten valve tubes; and their famous tilted anode tubes with copper cathode cups. A complete assortment of rotating anode tube inserts, and the HRZ-1, HRZ-2, and HRZ-3 rotating anode units will also be shown.



E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del. (Booths 57-60): The Du Pont Photo Products Department will feature a new intensifying screen development. Radiographs showing the exposure comparison between Par Speed and Hi-Speed screens will also be on display. In addition, a part of the exhibit will be devoted to dosimeter films for personnel monitoring.

EASTMAN KODAK COMPANY, Rochester, N. Y. (Booths 97-98; 109-110), will show the Kodak X-Omat Processor, Model M. With a processing cycle of only six minutes, this machine processes, without hangers, up to 240 films (intermixed sizes) per hour. Its many other advantages and economies will also be demonstrated. The new fast Kodak Royal Blue medical x-ray film, with which substantial exposure reduction is being achieved, will also be displayed.

EUREKA X-RAY TUBE CORPORATION, Chicago, Ill. (Booth 76).

FAIRCHILD CAMERA AND INSTRUMENT CORPORATION, Industrial Camera Division, Jamaica, N. Y. (Booths 100-101): The Fairchild exhibit will feature the new Fairchild-Odelca 4 × 4-inch Mirror-Optic Photofluorographic camera. This extremely fast mirror-optic system permits exposures at only one-fourth the time normally required for photofluorography; at the same time definition is markedly improved. The Fairchild-Odelca 4 × 4-inch camera handles up to 100 sheets of 4 × 4-inch cut film automatically, requiring no loading of individual cassettes, and makes possible the use of photofluorography for many applications in addition to that of tuberculosis detection.

FORSYTH X-RAY CORPORATION, Chicago, Ill. (Booth 90).

E. FOUGERA & Co., Hicksville, N. Y. (Booth 84): Featured at this exhibit will be Visciodol, which is indicated for radiographic visualization of the bronchopulmonary apparatus during bronchography. It permits the high radiopacity and known blandness of its parent compound, lipiodol, plus the significant advantages of rapid elimination and virtually no filling of the alveoli.

FRANKLIN X-RAY CORPORATION, Philadelphia, Penna. (Booths 70-71) will display a floor-to-ceiling head stand for precision work in examining the skull, sinuses, and many other parts of the body. The Franklin rapid film changer for angiographic examinations will also be shown. This permits 6 exposures per second, with the receiver magazine having a capacity of 36 films. The film, which is on a roll, may be processed as roll film or cut film as desired. Film frame size is 11 × 14 inches, allowing the examination of most parts.

GENERAL ELECTRIC COMPANY, Milwaukee, Wis. (Booths 30-36).

M. J. GORDON CONSULTING ENGINEERS, New York, N. Y. (Booth 45), will exhibit the Gordon full-size x-ray projector, with better than 650,000 beam candle powers of cool light, now used by all the principal teaching hospitals of New York City and by the New York Roentgen Society. It projects an 18-inch-diameter transparency, is extremely light weight, and easily transportable. They will also show the Gordon vest pocket stereoscope in use by the U. S. Armed Forces and the special light box with easily controlled internal shades for use with the Gordon projector or alone.

GRUNE & STRATTON, INC., New York, N. Y. (Booth 40). Mr. Frank Kurzer will welcome visitors to Booth 40, where they may examine many new publications. Among these are Schinz, Glauner, and Uehlinger's *Progress in Roentgen-Diagnostics*; Lassrich, Prevot, and Schafer's *Pediatric Roentgenology*; Köhler's *Borderlands of the Normal and Early Pathologic in Skeletal Roentgenology*; Schinz, Baensch, Friedl, and Uehlinger's *Roentgen-Diagnostics, Volumes I-IV*; Storch's *Fundamentals of Clinical Fluoroscopy*, second revised edition, as well as many other important books in the radiological field.

HALSEY X-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 102-103), cordially invites all members and guests to examine at their commercial exhibit, the following remarkable new items: Multi-Sette, a finely engineered multi-film cassette designed for body-section roentgenography; Magni-Viewer, a 70-mm. roll film and combination 4 × 4-inch, 4 × 5-inch, and 70-mm. cut film magnifying photofluoroscopic film viewer; and the high impact Styron shell illuminators designed for desk and wall mounting in addition to panoramic banking. The outstanding line of accessories always offered by Halsey will make up the balance of the display.

HIGH VOLTAGE ENGINEERING CORPORATION, Burlington, Mass. (Booth 65): The theme of the High Voltage Engineering Corporation exhibit at Booth 65 will be the latest in supravoltage x-ray equipment capable of handling a full-scale clinical program. The exhibit will feature illustrations of the 2-MEV Van de Graaff, showing a trouble-free sealed x-ray tube, and a display of beam-defining equipment. High radiation output, sharp field definition, and ease of operation are characteristics of the Van de Graaff x-ray generators for radiation therapy that will be displayed.

PAUL B. HOEBER, INC., Medical Book Department of Harper & Brothers, New York, N. Y. (Booth 44): Members and visitors of the Radiological Society of North America are cordially invited to browse at leisure among the books published by Hoerber-Harper. Of particular interest is the new edition in English of *Radiologic Gynecology and Radiography of the Breast*, by Dalsace and Garcia-Calderon. Pack and Ariel's *Tumors of the Soft*

*Somatic Tissues* and Naclerio's *Bronchopulmonary Diseases* will also be available for examination, as well as proofs of the new Milch and Milch's *Fractures*.

HOWDON VIDEX PRODUCTS CORPORATION, Mount Vernon, N. Y. (Booth 64).

ILFORD, INC., New York, N. Y. (Booth 12).

THE INTERNATIONAL MEDICAL RESEARCH CORPORATION, New York, N. Y. (Booth 50), will show its new Bucky combination therapy unit. This apparatus will produce as much as 20,000 r per minute, making it ideal for any type of cavity or whole-body irradiation. The kv control is stepless from 5 kv to 140 kv depth dosage. The unit therefore offers the following therapy modalities: intermediary, beryllium-window superficial therapy, contact and grenz ray therapy. Also shown will be the new Bucky grenz ray therapy units which afford an extremely great output.

R. S. LANDAUER, JR., AND COMPANY, Park Forest, Ill. (Booth 29), will exhibit and furnish information on its badge services for radiation safety. Included among these will be body, wrist, and ring badge services for accurate monitoring of personnel exposure to x-rays, gamma rays, beta particles, and neutrons.

LEA & FEBIGER, PUBLISHERS, Philadelphia, Penna. (Booth 15), welcomes members and guests to Booth 15, where they may examine such books as Cipollaro's *X-Rays and Radium in the Treatment of Diseases of the Skin*; Ritvo's *Chest X-Ray Diagnosis*; Davidoff and Epstein's *The Abnormal Pneumoencephalogram*; Holmes and Robbins's *Roentgen Interpretation*; Ritvo's *Bone and Joint X-Ray Diagnosis*; Epstein's *The Spine*; Rhinehart's *Roentgenographic Technique*; Epstein and Davidoff's *Atlas of Skull Roentgenograms*; Delario's *Roentgen, Radium and Radioisotope Therapy*; Ritvo and Shaufer's *Gastrointestinal X-Ray Diagnosis*; Davidoff and Dyke's *The Normal Encephalogram*; Shurtleff's *Children's Radiographic Technique*; Holmes and Schulz's *Therapeutic Radiology*; and many others.

LIBERTY PROTECTIVE LEATHERS, INC. Gloversville, N. Y. (Booth 82).

LEISHMAN X-RAY ENGINEERING COMPANY, Los Angeles, Calif. (Booth 96).

THE LIEBEL-FLARSHEIM COMPANY, Cincinnati, Ohio (Booth 99).

LOGETRONICS, INC., Alexandria, Va. (Booths 116-117): The LogEtronics exhibit will feature the new LogEtronic x-ray printer which automatically brings out detail in bone and tissue portions of the same film. Transparencies, paper prints, and lantern slides will be displayed to illustrate how LogEtronics makes x-ray detail more easily visible,

saves on "retakes" due to improper exposure or processing, and makes possible better illustrations in technical journals and more effective exhibits and lectures.

LOW X-RAY FILM CORPORATION, New York, N. Y. (Booths 51-52): Gevaert x-ray film is produced by one of the world's oldest and largest manufacturers of x-ray and photographic emulsions. Please call at Booths 51 and 52 for information on Gevaert's complete line of photoroentgen film for all types of x-ray cameras. Also ask about Gevaert's extra wide latitude film—high kv film, the original individually wrapped non-screen film that requires no darkroom loading.

MACHLETT LABORATORIES, INC., Springdale, Conn. (Booths 111-112), will exhibit several of the series of Dynamax rotating anode x-ray tubes. Of particular interest are the Dynamax "OR 40" and Dynamax "150." Dynamax "OR 40" is specially designed for use in hospital operating rooms. Dynamax "150" provides extremely high heat storage capacity and heat dissipation rate together with maximum voltage ratings to 150 pkv; this x-ray tube is designed for special diagnostic applications, including angiocardiology. Machlett low drop valve tubes, incorporating thoriated-tungsten filaments, will also be exhibited.

MALLINCKRODT CHEMICAL WORKS, St. Louis, Mo. (Booth 94): Members and guests of the Radiological Society of North America are cordially invited to visit the Mallinckrodt Chemical Works exhibit in Booth 94, where there will be displayed contrast materials, such as Miokon Sodium 50 per cent for visualization of the kidney, ureters and bladder, Urokon 30, 50 and 70 per cent for retrograde pyelography, cerebral angiography and angiocardiology. Featured at the meeting will be a new compound, Thixokon, for urethrography. Thixokon, a brand of thickened sodium acetizoate solution, is a sterile, aqueous solution containing 50 per cent w/v of the sodium salt of Urokon 50 per cent. The representative in attendance will be glad to discuss questions concerning these products.

MATTERN X-RAY DIVISION, Land Air, Inc., Chicago, Ill. (Booths 74-75), will show a completely new line of x-ray apparatus, consisting of a motor-driven tilting table, a tube stand, and a control. The equipment has modern styling and brings 2-tone colors to the x-ray industry. The motor-driven table includes a simple, dependable, semi-automatic spot-film device. X-ray protection for the radiologist and technician has been carefully considered during design. The tube stand provides the utmost flexibility and ease in positioning the radiographic tube. The control includes circuit innovations which will maintain the Mattern reputation for electrical dependability.

DONALD MC ELROY, INC., Chicago, Ill. (Booth 78).

MEDICAL, DENTAL, SCIENTIFIC PHOTOGRAPHIC EQUIPMENT COMPANY, Levittown, Penna. (Booth 95), will feature a line of photographic equipment using the patented Close-Up Ring as the basic light source. Prices of complete set-ups, including the camera, start at \$135.15.

MICRO X-RAY RECORDER, Chicago, Ill. (Booth 119): The new Micro X-Ray Recorder projector-viewer for 2 X 2-inch slides, 35-mm. rolls or strips, that will not buckle film even after hours of projection, will be demonstrated for the first time at this meeting. The newest model of the Micro X-Ray Recorder, a microfilming unit that will record x-rays, photographs, charts, EKG's, case histories and specimens, on a 100-foot roll of 35-mm. film, is featured. Accessories such as hand-viewers, indexers, film mounts, and strip filer cards will also be shown. Latest releases of the Micro X-Ray Recorder 2 X 2-inch collection series of teaching films and all previous series will be available for viewing or projecting.

MID-WEST GLOVE CORPORATION, Chicago, Ill. (Booth 79): Security gloves are the popular flexible type, made by a patented process which eliminates almost all seams. As a result, Security gloves are safe to use. Security aprons similarly incorporate the most advanced features for safety and comfort. Interesting comparative x-ray films of various gloves will be on display. Compare these films with films of your gloves for your protection.

NORTH AMERICAN PHILLIPS COMPANY, INC., Mount Vernon, N. Y. (Booths 53-56).

NUCLEAR CORPORATION OF AMERICA, St. Louis, Mo. (Booths 66-68).

NUCLEAR-CHICAGO CORPORATION, Chicago, Ill. (Booth 113), will show a complete line of radioisotope-measuring and detection instruments for clinical studies. Included will be a complete line of probe type scintillation detectors, scintillation detectors for sample determinations, a completely redesigned group of scalers, rate-meters and portable survey instruments, and an exclusive new combination instrument which consists of a gamma-ray spectrometer, precision scaler, and automatic computing circuits. An isotope scanning system with a photo-recording attachment will be demonstrated.

PAKO CORPORATION, Minneapolis, Minn. (Booths 41-43).

PHYSICIANS TECHNICAL EQUIPMENT COMPANY, Milwaukee, Wis. (Booth 104).

PICKER X-RAY CORPORATION, White Plains, N. Y. (Booths 18-23, 77).

PROFEXRAY, INC., Maywood, Ill. (Booths 80-81).

R-P CORPORATION, St. Louis, Mo. (Booth 63).

RADIOLOGY, Detroit, Mich. (Booth 125): The official journal of the Radiological Society of North America is presenting a photographic exhibit, showing its Editorial and Business Offices and the printing plant which is responsible for its production. Photographs of the Editor and Assistant Editors, the Business Manager, and members of the Publication Committee and the Editorial Advisory Board will serve to acquaint members of the Society with those who are responsible for the high standing of RADIOLOGY among medical publications.

RADIUM CHEMICAL COMPANY, INC., New York, N. Y. (Booth 14).

SCHICK X-RAY COMPANY, Chicago, Ill. (Booth 62), is the exclusive distributor, for the United States, of Elema-Schönander Equipment made in Stockholm, Sweden. Its exhibit will feature the original Lysholm (CRT/4) skull unit with the new motor-driven body-section device. Also available through your dealer are angiographic film-changers of different sizes for roll or cut film, 300 ma. mobile units, automatic high-pressure syringes, and many other special apparatuses.

FRANK SCHOLZ X-RAY CORPORATION, Boston, Mass. (Booth 93).

SIEMENS NEW YORK INC., New York, N. Y. (Booths 85-86): Selenium rectifiers, replacing valves, are the outstanding feature of the Siemens Tridoros 4, a 3-phase generator of 1000 ma. capacity offering exposure times down to 0.003 second and simultaneous operation of 2 tubes. Also shown will be the Siemens table with Catapult Bucky and floor-ceiling tube stand, which lends itself to many uses besides regular radiography, as enlargement work, angiography of abdomen and extremities, and multi-section planigraphy. It can be readily combined with a cassette changer for cerebral angiography.

E. R. SQUIBB & SONS, New York, N. Y. (Booth 38), has long been a leader in the development of new agents for prevention and treatment of disease. The results of the Company's diligent research are available to the medical profession in new products or improvements in products already marketed. Representatives are happy to present up-to-date information on these advances for your consideration.

STANDARD X-RAY COMPANY, Chicago, Ill. (Booths 8-11), will show x-ray apparatus of the latest design and development. Members of the Radiological Society of North America and guests are invited to visit this exhibit, where attendants will be glad to demonstrate equipment and discuss requirements and plans to fit into any needs.

CHARLES C THOMAS, Publisher, Springfield, Ill. (Booth 87): Now in its fifty-first year, *The American Journal of Roentgenology, Radium Therapy and Nuclear Medicine*, edited by Lawrence Reynolds, is

featured in this display. It is the official journal of The American Roentgen Ray Society and The American Radium Society. Also displayed are new books in the field, including Ellinger's *Medical Radiation Biology* and Fuchs's *Principles of Radiographic Exposure and Processing*.

TRACERLAB, INC., Waltham, Mass. (Booths 120-124): Keleket will be showing its Flexaray Telecobalt apparatus, a floor-to-ceiling tube stand with the Keleket Fleetwood table and the Keleket Coronet table as well as many new items of dark room accessories and supplies. Tracerlab will be showing a series of radiation detector arms and carts for various types of uptake and localization measurements as well as low-background counting equipment and medical sources and radiation analysis appliances for the radiologist.

UNITED STATES RADIUM CORPORATION, Morristown, N. J. (Booth 72): In addition to its complete line of aluminized intensifying screens and screens incorporating lead blockers, the Radelin Division of the United States Radium Corporation will exhibit a new item: The Radelin Matched Screen Book, developed for multiple simultaneous polytomography. Suitable for use with all available polycassettes, the Radelin Screen Book consists of 7 sets of matched special screens, permitting up to 7 simultaneously exposed films at 1-cm.-level differences.

UNIVERSAL X-RAY PRODUCTS, INC., Chicago, Ill. (Booth 73): Universal, manufacturers of fine x-ray equipment for over thirty years, will have on display a new "Mobilemaster 200." This unique and different 200-ma. mobile unit is one of a series of mobile and portable units ranging in capacity from 30 ma. to 200-ma. Universal will also have available a wide variety of low-priced fluoroscopic-radiographic, and the very popular skin therapy x-ray and grenz-ray equipment.

THE VICTOREEN COMPANY, Cleveland, Ohio (Booth 61).

VOLK RADIOCHEMICAL COMPANY, Chicago, Ill. (Booth 39), will exhibit unique products and services for nuclear medicine provided by this company, including: radioactive pharmaceuticals in precalibrated individual dosage forms—radioiodine, radiophosphorus, and other isotopes of clinical importance; isotope laboratory equipment—shielded syringes, stainless steel trays, lead shielding, and

personnel monitoring devices. Dr. M. E. Volk and Mr. J. F. Penksa will be in attendance.

WESTINGHOUSE ELECTRIC CORPORATION, Pittsburgh, Penna. (Booths 1-6).

WILLIAMS & WILKINS COMPANY, Baltimore, Md. (Booth 69).

WINTHROP LABORATORIES, New York, N. Y. (Booth 28), will feature in their display Telepaque, the highly effective and well tolerated oral cholecystopaque medium which gives dense, clear-cut pictures of the gallbladder and, in a substantial number of cases, also permits visualization of the biliary ducts; Hypaque sodium, a 50 per cent sterile solution (ampules of 30 c.c.), a new, well tolerated, highly radiopaque medium for excretion urography, containing 59.87 per cent iodine, which produces excretory urograms of a clarity approaching that usually obtained by the retrograde method; Hypaque M 90 per cent, a concentrated solution of Hypaque sodium with Hypaque methylglucamine for angiocardiology, supplied in vials of 50 c.c. with dual-purpose caps (permitting withdrawal by needle as well as by pouring).

WOLF X-RAY PRODUCTS, INC., Brooklyn, N. Y. (Booths 46-49), will display a complete line of their manufactured x-ray accessories. The featured items will be a newly designed stainless-steel, 5-gallon tank; the recently introduced File Stak, the modern method for filing x-ray negatives; a complete line of x-ray protective material, including the famous Wolf Superflex aprons and Wolf Superflex gloves. Current literature will be distributed, including the latest edition of a one-hundred page catalog, illustrating the complete line.

YEAR BOOK PUBLISHERS, INC., Chicago, Ill. (Booth 118): Publication of a number of new titles adds a distinct note of timeliness to the Year Book Publishers' exhibit. Fields and Seed's *Clinical Use of Radioisotopes* is now available; also the new *Year Book of Cancer*, the new second edition of Johnson and Kirby's *Chest Surgery*, the new Welch's *Intestinal Obstruction*, the new *Year Book of Radiology*, and others. In addition, all of the many standard works in the field of radiology published by "Year Book" will be available to those who may not have had the opportunity to examine them previously.



## RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

*Editor's Note:* Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

- RADIOLOGICAL SOCIETY OF NORTH AMERICA.** *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.
- AMERICAN RADIUM SOCIETY.** *Secretary*, Theodore R. Miller, M.D., 139 E. 36th St., New York 16, N. Y.
- AMERICAN ROENTGEN RAY SOCIETY.** *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.
- AMERICAN COLLEGE OF RADIOLOGY.** *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.
- ASSOCIATION OF UNIVERSITY RADIOLOGISTS.** *Secretary-Treasurer*, Paul Riemenschneider, M.D., Department of Radiology, Medical College, State University of New York, Syracuse, N. Y.
- SECTION ON RADIOLOGY, A. M. A.** *Secretary*, T. Leucutia, M.D., 10 Peterboro, Detroit 1, Mich.
- SOCIETY OF NUCLEAR MEDICINE.** *Secretary*, Robert W. Lackey, M.D., 452 Metropolitan Bldg., Denver 2, Colo.
- Alabama**
- ALABAMA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.
- Arizona**
- ARIZONA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, R. Lee Foster, M.D., 1313 N. Second St., Phoenix. Annual meeting with State Medical Association; interim meeting in December.
- Arkansas**
- ARKANSAS RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith. Meets quarterly.
- California**
- CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY.** *Secretary*, Nathan M. Spishakoff, M.D., 405 N. Bedford Drive, Beverly Hills.
- EAST BAY ROENTGEN SOCIETY.** *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.
- LOS ANGELES RADIOLOGICAL SOCIETY.** *Secretary*, Putnam C. Kennedy, M.D., 540 N. Central Ave., Glendale 3. Meets second Wednesday, September, November, March, April, and June, Los Angeles County Medical Association Building.
- NORTHERN CALIFORNIA RADIOLOGICAL CLUB.** *Secretary*, H. B. Steward, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.
- PACIFIC ROENTGEN SOCIETY.** *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.
- RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA.** *Secretary-Treasurer*, Harold P. Tompkins, M.D., 658 S. Westlake, Los Angeles 57.
- SAN DIEGO RADIOLOGICAL SOCIETY.** *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.
- SAN FRANCISCO RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Irma Smith, M.D., 450 Sutter St., San Francisco 8. Meets quarterly, at Grison's Steak House.
- SOUTH BAY RADIOLOGICAL SOCIETY.** *Secretary*, Howard L. Jones, M.D., Palo Alto Hospital, Palo Alto. Meets monthly, second Wednesday.
- X-RAY STUDY CLUB OF SAN FRANCISCO.** *Secretary*, John H. Heald, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:30, P.M. Children's Hospital, September through June.
- Colorado**
- COLORADO RADIOLOGICAL SOCIETY.** *Secretary*, Lorenz R. Wurtzbaach, M.D., 601 E. Nineteenth Ave., Denver 5. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.
- Connecticut**
- CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY.** *Secretary-Treasurer*, Ralph J. Littwin, M.D., Bristol Hospital, Bristol. Meets bimonthly, second Wednesday.
- District of Columbia**
- RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY.** *Secretary-Treasurer*, Charles E. Bickham, Jr., M.D., 1835 Eye St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, 8:00 P.M., in Medical Society Library.
- Florida**
- FLORIDA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, C. Robert DeArmas, M.D., 135 Broadway, Daytona Beach. Meets in April and in October.
- GREATER MIAMI RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, George P. Daurelle, M.D., Jackson Memorial Hospital, Miami 36. Meets monthly, third Wednesday, 8:00 P.M., at Mercy Hospital.
- NORTH FLORIDA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.
- Georgia**
- ATLANTA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, J. Luther Clements, Jr., M.D., 35 Linden Ave., N.E., Atlanta 8. Meets second Friday, September to May.
- GEORGIA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg., Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.



**RICHMOND COUNTY RADIOLOGICAL SOCIETY.** *Secretary,* Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

### Hawaii

**RADIOLOGICAL SOCIETY OF HAWAII.** *Secretary-Treasurer,* Jun-chu'an Wang, M.D., The Queen's Hospital, Honolulu 9. Meets third Monday of each month.

### Illinois

**CHICAGO ROENTGEN SOCIETY.** *Secretary-Treasurer,* Arthur S. J. Petersen, M.D., 11406 S. Parnell Ave., Chicago 28. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

**ILLINOIS RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

**ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY.** *Secretary,* William Meszaros, M.D., 1825 W. Harrison St., Chicago.

### Indiana

**INDIANA ROENTGEN SOCIETY.** *Secretary-Treasurer,* Chester A. Stayton, Jr., M.D., 313 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

**TRI-STATE RADIOLOGICAL SOCIETY** (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer,* Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

### Iowa

**IOWA RADIOLOGICAL SOCIETY.** *Secretary,* James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

### Kansas

**KANSAS RADIOLOGICAL SOCIETY.** *Secretary,* James R. Stark, M.D., 3244 East Douglas St., Wichita. Meets in the Spring with the State Medical Society and in the Winter on call.

### Kentucky

**KENTUCKY RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* Robert H. Akers, M.D., 1405 West Broadway, Louisville 3. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

### Louisiana

**ORLEANS PARISH RADIOLOGICAL SOCIETY.** *Secretary,* Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

**RADIOLOGICAL SOCIETY OF LOUISIANA.** *Secretary-Treasurer,* Seymour Ochsner, M.D., Ochsner Clinic, New Orleans 15.

**SHREVEPORT RADIOLOGICAL CLUB.** *Secretary,* W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

### Maine

**MAINE RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* Francis J. O'Connor, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

### Maryland

**BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION.** *Secretary-Treasurer,* James K. V. Willson, M.D., 1100 N. Charles St., Baltimore 1. Meets third Tuesday, September to May.

**MARYLAND RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

### Michigan

**DETROIT X-RAY AND RADIUM SOCIETY.** *Secretary-Treasurer,* Dr. Joseph O. Reed, Jr., 3825 Brush St., Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

**UPPER PENINSULA RADIOLOGICAL SOCIETY.** *Secretary,* Arthur Gonty, M.D., Menominee. Meets quarterly.

### Minnesota

**MINNESOTA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* O. J. Baggenstoss, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets three times a year, in Fall, Winter, and Spring.

### Mississippi

**MISSISSIPPI RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* Robert P. Henderson, M.D., 316 Medical Arts Bldg., Jackson. Meets monthly, on third Tuesday, at 6:30 P.M., at the Hotel Edwards, Jackson.

### Missouri

**RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY.** *Secretary-Treasurer,* D. R. Germann, M.D., University of Kansas Medical Center, Kansas City 3, Kans. Meets last Friday of each month.

**GREATER ST. LOUIS SOCIETY OF RADIOLOGISTS.** *Secretary,* Thomas F. Maher, M.D., 634 N. Grand Blvd., St. Louis, Mo. Meets on fourth Wednesday, October to May.

### Montana

**MONTANA RADIOLOGICAL SOCIETY.** *Secretary,* John Stewart, M.D., Billings Clinic, Billings. Meets annually.

### Nebraska

**NEBRASKA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer,* James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

**New England**

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thomas J. Crowe, M.D., 53 Center St., Northampton, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Raymond A. Dillon, M.D., 24 Wedgemere Ave., Winchester, Mass. Meets monthly on third Friday, October through May, at the Hotel Commander, Cambridge, Mass.

**New Hampshire**

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnson, M.D., 127 Washington St., Keene.

**New Jersey**

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Dr. Andrew P. Dedick, Jr., M.D., 67 E. Front St., Red Bank. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

**New York**

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Solomon Schwartz, M.D., 555 Prospect Pl. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles Bernstein, M.D., 685 Delaware Ave., Buffalo. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ernest I. Melton, M.D., 2187 Ocean Ave., Brooklyn. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Jerome Zwanger, M.D., 126 Hicksville Road, Massapequa. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold G. Jacobson, M.D., Montefiore Hospital, 210th St. and Bainbridge Ave., New York 67, N. Y.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving Van Woert, Jr., M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF STATE OF NEW YORK. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, John W. Colgan, M.D., 277 Alexander St., Rochester 18. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arnold Myron Wald, M.D., 406 Boston

Post Road, Port Chester. Meets third Tuesday of January and October and at other times as announced.

**North Carolina**

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in April and October.

**North Dakota**

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

**Ohio**

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary*, Francis C. Curtzwiler, M.D., 421 Michigan St., Toledo 2.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Frederick A. Rose, M.D., 2065 Adelbert Road, Cleveland 6. Meets at 7:00 P.M., fourth Monday, October, November, January, February, March and April, at Tudor Arms Hotel.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Warner A. Peck, Jr., M.D., 441 Vine St., Cincinnati 2. Meets first Monday, September through May, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. D. Robertson, M.D., Miami Valley Hospital, Dayton 9. Meets monthly, second Friday.

**Oklahoma**

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sol Wilner, M.D., Medical Arts Bldg., Tulsa.

**Oregon**

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. V. Allen, M.D., 9855 S.W. Hawthorne Lane, Portland. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

**Pacific Northwest**

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert Hanf, M.D., 807 South Auburn, Kennewick, Wash. Meets annually in May.

**Pennsylvania**

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Roderick L. Tondreau, M.D., 3400 Spruce St., Philadelphia 4. Meets first Thursday of each

month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

**PITTSBURGH ROENTGEN SOCIETY.** *Secretary*, Edward M. Schultz, M.D., 3401 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

#### Rocky Mountain States

**ROCKY MOUNTAIN RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, John H. Freed, M.D., 4200 E. Ninth Ave., Denver 20, Colo.

#### South Carolina

**SOUTH CAROLINA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Wayne Reeser, M.D., 1600 Ninth Ave., Conway. Meets with State Medical Association in May.

#### South Dakota

**RADIOLOGICAL SOCIETY OF SOUTH DAKOTA.** *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

#### The Southeast

**Southern Radiological Conference.** *Secretary-Treasurer*, Marshall Eskridge, M.D., 1252 Springhill Ave., Mobile, Ala.

#### The Southwest

**SOUTHWESTERN RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Gordon L. Black, M.D., 1501 Arizona Bldg., El Paso, Texas.

#### Tennessee

**MEMPHIS ROENTGEN SOCIETY.** *Secretary-Treasurer*, James L. Booth, M.D., 899 Madison Ave., Memphis 3. Meets monthly first Monday, John Gaston Hospital.

**TENNESSEE RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Association in April.

#### Texas

**DALLAS-FORT WORTH RADIOLOGICAL CLUB.** *Secretary*, Albert H. Keene, M.D., 3707 Gaston Ave., Dallas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

**HOUSTON RADIOLOGICAL SOCIETY.** *Secretary*, John M. Phillips, M.D., Hermann Hospital, Houston 25. Meets fourth Monday at the Doctors' Club.

**SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY.** *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets at Brook Army Medical Center, second Wednesday of each month.

**TEXAS RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Jarrell E. Miller, M.D., 3500 Gaston Ave., Dallas 26. Next meeting in San Antonio, Jan. 24-25, 1958.

#### Utah

**UTAH STATE RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

#### Virginia

**VIRGINIA RADIOLOGICAL SOCIETY.** *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

#### Washington

**WASHINGTON STATE RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

#### West Virginia

**WEST VIRGINIA RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, W. Paul Elkin, M.D., 515-519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

#### Wisconsin

**MILWAUKEE ROENTGEN RAY SOCIETY.** *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

**SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN.** *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

**UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE.** Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

**WISCONSIN RADIOLOGICAL SOCIETY.** *Secretary-Treasurer*, Farrell F. Golden, M.D., 5221 Tonyawatha Trail, Madison 4.

#### Puerto Rico

**ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA.** *Secretary-Treasurer*, Dr. R. B. Díaz Bonnet, Suite 504, Professional Bldg., Santurce, P.R.

#### CANADA

**CANADIAN ASSOCIATION OF RADIOLOGISTS.** *Honorary Secretary-Treasurer*, Guillaume Gill, M.D.; *Associate Honorary Secretary-Treasurer*, Robert G. Fraser, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

**LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES.** *General Secretary*, Louis Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

**L'ASSOCIATION DES RADIOLOGISTES DE LA PROVINCE DE QUEBEC.** *ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC.* *Secretary*, Isadore Sedlezky, M.D., 3755 Cote St. Catherine Road, Montreal. Meets four times a year.

#### CUBA

**SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA.** *Secretary*, Dr. Rafael Gomez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

#### MEXICO

**SOCIEDAD MEXICANA DE RADIOLOGÍA.** A. C. *Headquarters*, Calle del Oro, Núm. 15, Mexico 7, D. F. *Secretary General*, Dr. Guillermo Santin, Calle del Oro, Núm. 15, Mexico 7, D.F. Meets first Monday of each month.

#### PANAMA

**SOCIEDAD RADIOLOGICA PANAMEÑA.** *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

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## ROENTGEN DIAGNOSIS

### THE HEAD AND NECK

**Angiography in the Diagnosis of Cerebral Tumors.**  
Alein Saldanha. *Gaz. méd. port.* 9: 659-676, November-December 1956. (In French) (Centro de Estudos Egas Moniz, Lisbon, Portugal)

This paper, published in an issue dedicated to the memory of the Portuguese neurologist, Egas Moniz (1874-1956), is based on 350 cerebral angiographic studies, and their correlation with the histologic findings determined at surgery and/or autopsy. The cases are from the collection of Moniz, who introduced this procedure in 1927.

The presence of a cerebral tumor may be revealed during angiography by one or more of the following vascular alterations: (1) changes in position of vessels, (2) changes in caliber of vessels, (3) appearance of abnormal vessels, (4) changes in the rapidity of the local circulation, (5) disappearance of certain circulatory phases.

In 82 per cent of all cases of glioma there was some deviation of vessels, and in all but 4.6 per cent of these the displacement corresponded to the location of the tumor. The 18 per cent in which the vessels followed a normal course included 7 per cent in which the neoplasms were situated near the midline and 6 per cent with reduced blood flow, leaving 5 per cent true failures of the method. These, it is believed, could have been minimized by employing both frontal and lateral projections instead of only the lateral.

Caliber changes are less constant and must be interpreted with caution to avoid confusion with functional disturbances. In 22 per cent of the cases of glioma, the afferent artery seemed wider than the other cerebral vessels. In benign tumors there is a reduction in blood supply; in 19 (from the total of 28) cases of oligodendroglioma, the cerebral circulation was reduced.

The three phases (arterial, capillary, and venous) of the general cerebral circulation may also be encountered in the tumor itself, and should be carefully analyzed. There are space-occupying lesions without their own circulation (cystic astrocytoma, cholesteatoma, tuberculoma, abscess, etc.), and under such circumstances only a topographic diagnosis is possible.

The histologic characteristics of the neoplasm have a considerable influence on the circulation time. Typical are the dilated and sinuous capillaries in the angioma, which are seen early in the arterial phase, and disappear rapidly, without a venous phase. In the majority of tumors there is actually a slowing-down of the circulation, directly proportional to the number and degree of arterial deformities and dilatations within it. The abnormal vessels are especially well seen during the capillary phase, and persistence of contrast material within the tumor area beyond the time expected is a characteristic finding, believed to indicate malignancy.

In meningioma, the afferent vessels originate not only from the internal but very often also from the external carotid, which contributes to the increase in the circulation within the cranial vault, corresponding to the deep vascular grooves so often identified in the immediate vicinity of the tumor. There is often a delay in the evacuation of the tumor, and the capillary shadow persists into the second phlebographic phase. In meningioma, this persistent shadow is usually

homogeneous and well delineated, as opposed to the cloudy image in oligodendroglioma and astrocytoma. The presence of a dilated efferent vein is also considered indicative of malignancy. In such cases, there is often absence of the striated pattern of veins radiating from the lobe of the insula, a feature ("phlebographic lacuna") which is regarded as significant.

Based on these characteristics, the gliomas may be classified in three groups: Those in the *first* group, usually benign, show few circulatory changes, except for deviation of the vessels and a residual faint cloud of opaque medium, evacuated after a slight delay through a well preserved venous pattern; they are exemplified by the oligodendroglioma and astrocytoma, although in the latter one may find dilated vessels ("lakes" of Moniz). The *second* group, which includes the glioblastoma multiforme, is transitional between the first and the third, with vascular changes anywhere between minimal and advanced. The *third* group, the most malignant, shows definite vascular changes, especially well demonstrated at the periphery of the neoplasm, as circumscribed pseudonodular accumulations of contrast medium, eventually discharged through an abnormally dilated vein, in the absence of the usual venous pattern.

Twenty roentgenograms. E. R. N. GRIGG, M.D.  
Cook Country Hospital, Chicago

**Brain Tumors in Children. Clinical Analysis of 164 Cases.** Guy L. Odom, Courtland H. Davis, and Barnes Woodhall. *Pediatrics* 18: 856-869, December 1956. (Duke University School of Medicine, Durham, N. C.)

Among 28,385 children under sixteen admitted to Duke Hospital (Durham, N. C.) in the 12-year period from 1939 to 1951, 164 cases of brain tumor were seen, an incidence of 0.42 per cent. Seventy-four of the 164 tumors were supratentorial, while 90 were below the tentorium.

The *supratentorial tumors* included gliomas of the hemisphere; gliomas of the optic nerve, third ventricle and basal ganglia; craniopharyngiomas; meningeal sarcomas of the convexity; and an unclassified group. The initial complaint, headache in the majority of cases, dated back, on the average, to eleven and a half months prior to admission. Convulsions, motor impairment, and some visual disturbance were also of major significance. At admission, a common triad consisted of headache, vomiting, and papilledema. Visual dimness was prominent in the case of craniopharyngiomas and optic nerve gliomas. Cervical rigidity, enlargement of the head, and "cracked-pot" percussion sound occurred with decreasing frequency.

Routine stereoscopic views of the skull in various projections showed abnormalities in 51 of 53 cases of supratentorial tumors available for study. Localization of the lesion was possible in but few. In 25 of 26 cases of glioma, pressure changes were noted. These consisted of increased convolutional markings in 12, alterations in the sella in 10, and/or separation of sutures in 12. Enlarged optic foramina were observed in 4 patients with glioma of the optic nerve. Calcification was seen once each in an astrocytoma, ependymoma and oligodendroglioma. Other authors have pointed out the frequency of calcification in gliomas of the basal ganglia. Of the 25 non-gliomatous tumors, 24 showed

changes in the plain film studies. Pressure changes occurred in 8; an enlarged sella was noted twice with pituitary adenoma and once with a craniopharyngioma. Suprasellar calcification was demonstrated in 16 cases of craniopharyngioma, and once each in a chondroma and an unclassified tumor.

Although electroencephalography is a valuable adjunct in the screening for cerebral neoplasm, air studies must be used for surgical localization. Ventriculography with oxygen, as a preliminary procedure on the morning of the contemplated craniotomy, is a safe and reliable method except when the ventricles are inadequately visualized due to technical failure.

Of the 74 supratentorial tumors studied microscopically, 44 were gliomas and 30 non-gliomas. Ependymomas comprised 15 of the former group and craniopharyngiomas 17 of the latter category. The remainder of the cases covered the gamut of histopathological diagnoses.

In the 90 cases of *infratentorial tumor*, the 3 outstanding symptoms in order of frequency were vomiting, headache, and staggering gait. Less common were visual disturbances, enlargement of the head, cervical rigidity, episodic opisthotonos, decreased hearing, abdominal pain, and motor weakness. Papilledema occurred oftener with infratentorial tumors than with supratentorial tumors, while optic atrophy was seldom observed. The most common localizing sign, ataxia, occurred in 74 per cent of the cases. The five common sites of origin of the infratentorial tumors were: the pons, fourth ventricle, vermis, hemisphere, and cerebellopontine angle.

Of the 80 cases available for roentgenographic analysis, alterations were noted in 62, with sutural separation occurring in more than half and increased convolutional markings in half the cases. Only 8 showed alterations of the sella, usually consisting in enlargement of the fossa due to dilatation of the third ventricle. Calcification was noted once in an ependymoma of the fourth ventricle and once in an astrocytoma.

The 90 cases of *infratentorial tumor* were verified microscopically. The usual preponderance of astrocytomas over medulloblastomas was reversed, the authors finding 41 medulloblastomas to 30 astrocytomas.

The operative mortality in 70 cases of supratentorial tumors was 24 per cent; in 90 infratentorial tumors 20 per cent. Early surgical removal, with post-operative irradiation in selected cases, offers the greatest chance of survival and of palliation.

Fourteen tables.

SAUL SCHEFF, M.D.  
Boston, Mass.

**The Temporal Horn: Its Development, Normal Variations and Changes Associated with Non-Expanding Epileptogenic Lesions of the Temporal Lobe.** John M. Van Buren, Maitland Baldwin, and Ellsworth C. Alvord, Jr. *Acta radiol.* 46: 703-718, December 1956. (National Institute of Neurological Diseases, National Institutes of Health, Bethesda, Md.)

In the hope of throwing some light on the effect of non-expanding lesions of the temporal lobe upon the outline of the temporal horn as demonstrated pneumographically, the authors review the development of the latter structure and its normal anatomy and report their observations in 28 cases of temporal lobe epilepsy coming to operation.

Four general types of temporal horn are apparent in transverse section, based on the relationship of the collateral eminence to the floor of the ventricle or to the more medial lying hippocampus: (1) The collateral eminence fails to indent the ventricle. (2) It indents the medial portion of the ventricular floor just lateral to the hippocampus. (3) It indents the ventricular floor at its lowest point, producing a central elevation. (4) It indents the inferolateral angle of the temporal horn, producing a roughly T-shaped ventricular outline.

The procedure for demonstrating the temporal horns is described and the method of evaluation is outlined. Careful tracings were made of all portions of the horns visualized in each instance, and from these appropriate measurements were made. The following were selected as indicating abnormality: (1) over 3.0 mm. difference in the height of the lateral cleft of the two horns at either of two selected levels; (2) over 4.0 mm. total width of the lateral cleft. The term "lateral cleft" is used to designate that portion of the horn lateral to the hippocampus.

In 12 cases pneumography showed no signs corresponding to the clinical localization of the lesion; 13 lesions were correctly localized, and 3 incorrectly localized.

The criteria for measurements and the technics employed by the authors should be known to all interested in neuroradiology, and to these this paper is recommended.

Five roentgenograms; 11 photographs; 7 line drawings.

SAUL SCHEFF, M.D.  
Boston, Mass.

**Roentgenologic Manifestations of Tumors of the Acoustic Nerve.** Philip J. Hodes, J. Olin Perritt, Roderick L. Tondreau, and Adan Pitot. *Acta radiol. interam.* 6: 65-73, April-June 1956. (In Spanish) (P. J. H., 3400 Spruce St., Philadelphia 4, Penna.)

This is a comprehensive and important communication, giving an excellent summary of the historical aspects of roentgen recognition of tumors of the acoustic nerve, as well as the anatomy, pathology, clinical findings, and technics. The technical instructions are especially valuable and precise.

In summary, the authors state that the acoustic nerve is intimately related to the fifth and seventh cranial nerves, the intermediate nerve, and the anterior inferior cerebellar artery and vein, crossing the cerebellopontine angle in one single group. Due to this intimate relationship, these structures are often affected by acoustic tumors.

From the histologic point of view, the acoustic nerve tumors comprise three large classes: neurinoma, von Recklinghausen's neurofibroma, and von Recklinghausen's neurofibromatosis associated with meningioma. Acoustic neurinomas are generally single. When bilateral, they usually belong to the neurofibroma class, which is frequently of familial origin.

The clinical findings in acoustic tumor commonly follow a characteristic evolution. Early symptoms affect the fifth, seventh, and eighth cranial nerves. As the tumor grows, it exerts pressure on the protuberance and the cerebellum, causing ataxia, asymmetry and adiadochocinesia. Finally, increased intracranial pressure becomes manifest.

Radiologically these tumors are characterized by erosion of the internal auditory canal and by changes resulting from the increased intracranial pressure.



It is evident that approximately 80 per cent of the acoustic nerve tumors must be localized by the use of roentgenologic methods.

JAMES T. CASE, M.D.  
Santa Barbara, Calif.

**Roentgen Measurements of the Sella.** W. Bergerhoff. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 85: 695-708, December 1956. (In German) (Gutenbergstr. 89, Cologne-Ehrenfeld, Germany)

With lateral views of the skull, calculations of sellar size are easily possible and the grossly abnormal can be readily separated from the normal. Despite this and even after forty-five years of effort, the question of accuracy of diagnosis is still raised in borderline cases. This article is concerned with six common methods of measuring the sella turcica, with suggestions as to their comparative worth.

The original work on sellar measurements was done in 1808, by Hrdlička, who found the length of the pituitary fossa to average 11.1 mm. in the male and 10 mm. in the female, with an average depth of 9.1 to 9.4 mm. for both sexes. In 1910, Busi and Balli confirmed these measurements with a larger series giving the limits of normal as 8 to 15 mm. length and 5.5 to 11 mm. depth.

The second development in sellar measurement came in 1924, when Haas calculated the area of the projection of the sella. Haas worked with both ruled paper and a planimeter. With a focal spot-film distance of 92 cm., he arrived at 86.1 sq. mm.  $\pm 15.3$  for the male and 87.2 sq. mm.  $\pm 15.3$  for the female. On the basis of these measurements, Kovács constructed a *scala sellae* for the routine views. Today many sella measures made of transparent material, to be placed directly on the film, are available. The newer measurements give 78 to 96 sq. mm. as median values for the adult.

Fitzgerald attempted to measure the sella by relating its size to the size of the vault. At present, there is much difference of opinion as to this relationship, but even if it exists, it is not sufficient to be of clinical significance.

Due to the normal magnification which takes place on a roentgenogram, Lorenz developed a method based on the measurement of 2 projected angles which remain constant, regardless of focal spot-film distance. The angles utilized are formed by lines running from the lambdoid and coronal sutures to designated points on the sella wall. Mathematical difficulties, however, render this method impractical.

In 1905, Albers-Schönberg devised an orthophotographic procedure using a tube masked with a sheet of lead in which a thin slit has been cut. The tube is moved perpendicular to the line of slit across the object, reproducing its size in the direction of motion exactly. With two roentgenograms taken at right angles to each other, it is thus possible to measure size with no alteration due to magnification. Nürnberger and Schaltenbrand have used this method for measurement of the sella. They give 58 to 64 sq. mm. as the average projected area in a series of 231 normal adults.

A more recent development is that of Büchner, in which a ruler constructed of opaque material is placed along the bridge of the nose during exposure for the lateral view and direct readings are taken on the film.

The author finds certain objections to all of the procedures described. Büchner's technic is considered the most accurate and the cheapest, and it is this which is recommended. Bergerhoff's own method of deter-

mining characteristic angles (*Fortschr. a. d. Geb. d. Röntgenstrahlen* 77: 62, 1952) is also said to offer a reliable assessment of the profile of the sella.

Eight figures, including 1 roentgenogram.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Roentgen Diagnosis of Diseases of the Petrous Portion of the Temporal Bone.** C. E. Koch. *Röntgen-Blätter* 9: 377-394, December 1956. (In German) (Cologne, Germany)

The views described by Schüller, Stenvers, Mayer, and Chaussé all have their advantages for the demonstration of certain anatomic or pathologic details in the temporal bone. In each of these views, the angle of obliquity must be adapted to individual variations in order to bring out the desired plane. To this end, the author has developed an installation in which, by use of the image intensifier, exact positioning is achieved under fluoroscopic control, after which roentgenograms are exposed. This also permits adaptation of the technical factors to the degree of pneumatization or sclerosis demonstrated during fluoroscopy. Even stereographic procedures can be performed.

Several cases are presented, with special attention to the changes in acute and chronic otitis media, with or without osteomyelitis and/or cholesteatoma.

Twenty-five roentgenograms; 1 photograph; 1 drawing.

E. R. N. GRIGG, M.D.  
Cook County Hospital, Chicago

**The Roentgen Diagnosis of Some Unusual Skull Defects.** A. Knetsch. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 85: 687-695, December 1956. (In German) (Roonstr. 21, Hildesheim, Germany)

In dysostosis cleidocranialis aplasia or hypoplasia of the clavicles is associated with failure of the greater fontanelle to close. A lesser degree of dysostosis is represented by the persistence of the metopic fontanelle. This fontanelle is formed by the four centers of ossification of the frontal bone and is predicated on persistence, at least in part, of the metopic suture, which usually closes by the end of the second year of life. When the metopic fontanelle is seen in adult life, it is shown as a central radiolucency in the frontal region evident in both the postero-anterior and the lateral projections of the skull. It is frequently accompanied by hyperostosis frontalis interna. In the fully developed case, the radiolucent defect in the frontal bone extends into the greater fontanelle and beyond. A case illustrated in this article shows the skull divided into two segments in its anterior half.

Another rare skull anomaly is lückenschädel, more commonly known as craniofacialia. The skull shows, at birth, radiolucent areas very similar to enlarged digital markings bounded by arcuate bridges of denser bone. The original mechanical theory, attributing the defects to the pressure of the cerebral convolutions, can no longer be taken too seriously. The skull markings do not correspond to the anatomy of the brain and thus cannot be primarily pressure defects. The author considers the defect to be primary in the bone itself. He presents a case with co-existent anomalies involving the spine, ribs, pelvis, and abdominal muscles.

Twelve roentgenograms.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.



**Further Studies upon the Submucosal Compartments and Lymphatics of the Larynx by the Injection of Dye and Radioisotopes.** Joel Pressman, Andrew Dowdy, Raymond Libby, and Max Fields. *Ann. Otol., Rhin. & Laryng.* 65: 963-980, December 1956. University of California, Los Angeles 24, Calif.)

On the basis of work by Hajek demonstrating that submucosal compartments exist within the larynx, the authors have undertaken several experiments to demonstrate the location, confines, and communications of such compartments.

Solutions of 4 per cent direct sky blue dye were injected submucosally in various areas in the larynx in prelaryngectomy patients, in cadavers, and in living dogs and pigs. The results of cadaveric injections were assumed to represent submucosal spread only, while the results in living subjects, both human and animal, were felt to represent a combination of both direct submucosal spread and translymphatic extension. Because the dye, though eminently suitable for a visual short-term evaluation of results, was not suitable for long-term investigations, similar experiments were performed with a colloidal radioactive chromic phosphate ( $\text{Cr}^{51}$ ). For these latter experiments a scintillation scanning device especially constructed for laboratory animals was used, the final scans being obtained both before and after sacrifice of the animal at periods up to four weeks following injection.

The authors describe seven areas on each side of the larynx which are more or less separated one from the other in so far as the passage of injected fluids is concerned. Failure of fluids to pass by way of the lymphatics from one side of the larynx to the other was established for a period of as long as four hours in man, for twelve days in dogs in which dye was used, and for eight weeks in dogs receiving radioactive isotopes.

The experiments reported indicate that the interior of the larynx is divided into right and left halves from the lower level of the cricoid cartilage to and including the area of the epiglottic folds and epiglottis. This applies in man, the dog, and the pig. Considering each side independently, specific compartments are recognized to exist as follows: (1) from below the level of the true vocal cord at its medial margin to the lowermost limits of the larynx; (2) the medial border and part of the superior surfaces of the vocal cord itself; (3) the laryngeal sacculi; (4) the region of the ventricle, including the superior surface of the true vocal cord, the ventricle itself, and the inferior surface of the false vocal cord (the exact relationship between the ventricle and the sacculi has not been determined); (5) the lateral wall of the larynx, beginning at the free border of the false vocal cord and extending upward to the aryepiglottic folds and including the latter; (6) the lateral margins of the epiglottis beyond the limits of its cartilaginous portion; (7) the area outlined by the limits of the cartilaginous epiglottis.

It is pointed out that smaller subcompartments probably exist which, in all likelihood, include the synovial capsule of the cricoid arytenoid and cricothyroid articulations and the site of the cartilages of Wrisberg and Santorini, as well as an isolated compartment for the arytenoid cartilage itself.

The larynx is found to be essentially independent of the trachea, both from the standpoint of submucosal compartmentation and lymphatic channel distribution. Dyes injected into the membranous trachea just below the level of the inferior border of the cricoid

cartilage passed downward along the trachea and never upward into the larynx.

The information contained in this article has obvious clinical application, and should, we feel, be extended to include an investigation of the routes of lymphatic drainage from those areas of the intrinsic and extrinsic larynx where neoplasms are most apt to occur.

Fifteen figures.

JAMES E. BAUER, M.D.  
University of Missouri

**The Fluoroscope with Image Amplifier in the Study of the Larynx and Pharynx.** Brit B. Gay, Jr., and Sam A. Wilkins, Jr. *Cancer* 9: 1253-1260, November-December 1956. (Department of Radiology, Emory University School of Medicine, Atlanta, Ga.)

With the development of fluoroscopic image amplification, fluoroscopy has assumed an important role in the evaluation of laryngopharyngeal function and disease. The quality of the image obtained approaches that seen on conventional roentgenograms, the intensity of the light image from the fluoroscopic screen being increased some two hundred times over that with conventional equipment.

Complete x-ray examination of the larynx and pharynx consists of a lateral soft-tissue roentgenogram of the neck, frontal tomograms of the larynx during phonation and inspiration, and fluoroscopic study of the larynx in frontal and lateral planes before and after ingestion of barium sulfate. This method of examination has been carried out at Emory University Hospital on 62 patients during the past two years.

In some situations the roentgen examination as outlined will give information that may not be elicited from indirect or direct laryngoscopy. It may demonstrate ulcerations in a lesion which are hidden from view during laryngoscopy, identify invasions of the thyroid cartilage which are unrecognizable clinically, or determine the presence of subglottic extension of a bulky vocal-cord tumor. With large tumors of the supraglottic area, the vocal cords may be hidden from view clinically, while readily observed fluoroscopically, as to function, in the frontal plane. On occasion, the authors have recognized a vocal-cord paralysis fluoroscopically in a patient with mediastinal metastases before there was any clinical hoarseness to suggest invasion of the recurrent nerve. A patient with a tumor at the base of the tongue may have so much trismus that the lower extent of the tumor cannot be observed clinically, whereas roentgenologic studies will afford adequate localization without discomfort. Roentgen examination is valuable also in following the response to radiotherapy and in postoperative follow-up after hemilaryngectomy or cordectomy.

The roentgen examination, as described, is not meant to be in competition with clinical examination (history, physical examination, direct and indirect laryngoscopy) but rather to be an additional tool, allowing for more accurate evaluation of the patient afflicted with a tumor of the larynx or of the pharynx.

Seventeen roentgenograms.

**Roentgenologic Study of Tumors in the Hyo-Thyro-Epiglottic Space.** G. Motta and M. Piazzi. *Ann. radiol. diag.* 29: 432-481, 1956. (In Italian) (Clinica Otorinolaringologica dell'Università di Bologna, Bologna, Italy)

Direct and indirect laryngoscopy may not only be traumatizing but seldom do they demonstrate exactly

the extension, by continuity, of intrinsic and extrinsic tumors of the larynx. The authors describe 9 cases of laryngeal carcinoma in which the roentgen studies included (1) a lateral view of the cervical spine for soft-tissue detail, (2) a similar view obtained during performance of the Valsalva maneuver, (3) frontal tomograms of the larynx at 0.5-cm. intervals, (4) lateral tomograms of the larynx, focused on the mid-plane, and to 1.0 cm. either side of it, (5) a lateral esophagogram with thick barium suspension, and (6) frontal spot-films of the valleculae after barium ingestion. These 9 patients underwent total laryngectomy, and the surgical specimens were compared with the roentgenograms. A very significant degree of anatomical correlation is reported.

As is to be expected, proficiency in interpretation of the films requires constant attention to anatomical landmarks and inspection of the most minute changes in density, which should be identified not only in the frontal and lateral projections, but also on the body-section roentgenograms and the esophagogram.

Forty roentgenograms; 14 photographs; 1 drawing.

E. R. N. Grigg, M.D.

Cook County Hospital, Chicago

**Relation of Thyroid Enlargement to Tracheal Configuration. An Anatomicoroentgenologic Correlation.** Clarence Schein, Walter Lentino, and Harold G. Jacobson. *New England J. Med.* 255: 1072-1075, Dec. 6, 1956. (Montefiore Hospital, New York, N. Y.)

As one aspect of a study of thyroid adenomas the authors have considered the significance of the discrete thyroid nodule in relation to tracheal configuration. The point is stressed that the volume of the thyroid compartment is quite sharply limited by anatomical features, despite the soft-tissue nature of its elements. Consequently, even a small change in volume on one side will be reflected in the position and shape of the trachea. Seventeen cases of unilateral thyroid masses verified by operation or postmortem were analyzed as to degree and type of tracheal air column distortion manifested roentgenographically. It was found that a thyroid nodule in excess of 15 c.c. will usually produce some change in the air column, ordinarily a slight indentation on the homolateral side, without displacement of the trachea. As the nodule enlarges, the degree of tracheal shift or indentation increases correspondingly, so that with nodules of over 100 c.c. the homolateral side of the trachea will ordinarily be displaced beyond the midline with some narrowing.

Film studies were unsuccessful in differentiating malignant thyroid masses from benign lesions. It is concluded that the volume of the nodule and not its histologic nature is the important factor in determining the degree of tracheal displacement or compression. In 3 cases in which follow-up roentgenograms were obtained after removal of the thyroid nodule there was no reversal of the tracheal shift.

Three roentgenograms; 2 drawings; 1 table.

JAMES W. BARBER, M.D.

Cheyenne, Wyo.

**Tracheo-Esophageal Fistula without Esophageal Atresia—Congenital and Recurrent.** William K. Sieber and Bertram R. Girdany. *Pediatrics* 18: 935-942, December 1956. (B. R. G., 125 DeSoto St., Pittsburgh 13, Penna.)

The essential clinical feature of tracheo-esophageal

fistulas is severe intermittent respiratory distress coupled with abdominal distention. Cough of a peculiar rasping quality, severe dyspnea, cyanosis, noisy breathing and strangling are associated with oral or gastrostomy feedings and are allayed by continuous gastric suction. A presumptive diagnosis may be made when a tube passed into the stomach shows it to be continually filling with air under pressure as the infant cries and inspires actively. Definitive diagnosis rests upon the x-ray demonstration of the fistula.

The authors insert a soft-rubber catheter into the stomach under fluoroscopic control and then withdraw it to the level of the first thoracic vertebra. By means of a hand syringe, aqueous Dionosil is then instilled, and films are exposed in the prone, supine, and both lateral positions. For demonstration of a fistula that is functionally closed, the esophagus is gently distended with saline irrigations. If the instillation of saline is successful, the stomach will fill with air and respiratory distress ensue. The Dionosil esophagogram will then outline the fistula. Since saline distention of the esophagus is potentially hazardous, continuous-suction apparatus must be at hand.

Esophagoscopy and bronchoscopy separately or in combination have failed to outline the fistula in the hands of the authors. Other methods, including tracheography and methylene blue instillation into the trachea have been described but appear unnecessarily hazardous. Barium tends to dry on contact with air, and its use may be dangerous. Lipiodol is too viscous and Diodrast too dilute to give adequate visualization.

A recurrent tracheo-esophageal fistula may actually represent a second fistula overlooked at the time of the first operation or be due to impaired blood supply resulting from the primary operation. The seven recurrences studied by the authors all extended from the suture line of the esophagus to the original fistulous site in the trachea.

The poor prognosis associated with delay in surgical closure of the tract makes the early recognition and treatment of this condition imperative.

Four roentgenograms; 2 photographs.

SAUL SCHEFF, M.D.

Boston, Mass.

## THE CHEST

**Pulmonary Fibrosis and Collagen Diseases of the Lungs. A Symposium. I. Clinical Problems of Diffuse Pulmonary Fibrosis.** J. G. Scadding. *Brit. J. Radiol.* 29: 633-641, December 1956. (Institute of Diseases of the Chest, Brompton, London, S.W.3, England)

**II. Generalised and Primary Fibrosis of the Lungs.** J. Gough. *Brit. J. Radiol.* 29: 641-645, December 1956. (Department of Pathology, Welsh National School of Medicine, Cardiff, Wales)

**III. Pulmonary Fibrosis and the Collagen Diseases: Radiological Aspects.** Thomas Lodge. *Brit. J. Radiol.* 29: 645-656, December 1956. (Royal Hospital, Sheffield, Yorkshire, England)

I. Scadding discusses the diagnostic problems presented by diffuse reticular or nodular opacities on a chest film. In 1952 he listed 76 possible causes of such shadows (see *Tubercle* 33: 352, 1952), and to these 2 were subsequently added. In this paper all conditions presenting only acute symptoms are omitted from con-

sideration, leaving 48 possible causes of such shadows in patients with chronic symptoms or with none at all.

The occupational history may be sufficient to provide a diagnosis. In addition, a routine physical examination may furnish important clues to the final diagnosis, as in sarcoidosis, the tuberous sclerosis-adenoma sebaceum group, lupus erythematosus, or scleroderma. This phase of the examination may also reveal evidence of underlying disease in other systems. Thus, the presence of mitral stenosis may give a clue to the diagnosis of hemosiderosis. Biopsy may also be of aid. In some instances the total clinical-radiological picture may be so clear that the diagnosis can be made without extensive studies.

The author emphasizes the need of care in the interpretation of shadows of predominantly apical distribution. In spite of initial failure to detect tubercle bacilli, a persistent search may be rewarded by their eventual discovery. In sarcoidosis the radiological pattern is very characteristic, depending upon the stage of the disease. Lymphangitis carcinomatosa may mimic the intermediate stage of sarcoidosis, but the clinical symptoms are quite different; the dyspnea very soon becomes severe and the clinical picture is quite distinct. Patients with severe bronchitis and asthma may eventually show a diffuse coarse pattern in the lung, which may be a source of confusion, but the clinical history should be of help in diagnosis. Fibrocystic disease of the pancreas can be well recognized in young children, and in older patients diagnosis can be established by investigation of fat balance and trypsin. An esophageal obstruction may be the cause of an overflow of food into the bronchi giving rise to widespread fibrosis; examination of the esophagus should be undertaken whenever these conditions are suspected, however remotely. Chronic diffuse interstitial fibrosis of the lung, in the author's view erroneously associated with the names of Hamman and Rich, presents such a typical clinical-radiological picture that it can be recognized with a high degree of certainty. This is true also of idiopathic pulmonary hemosiderosis.

Occasionally routine laboratory investigation gives help in diagnosis of obscure cases of tuberculosis, eosinophilic infiltration of the lungs, and lupus erythematosus. Determination of the presence of proteins is often requested, although it is rarely of diagnostic importance, since so many of the possible causes of obscure pulmonary infiltration may be accompanied by a rise in the globulin fraction.

Radiological examination of the bones may sometimes give information of diagnostic value. About 5 per cent of the author's cases of sarcoidosis have at one time or another shown typical changes in the small bones of the hands and feet, but in all of these this feature appeared only after the diagnosis was already obvious from other considerations. Nor did the author find films of the long bones helpful in the diagnosis of xanthomatous honeycomb lung, although he saw one such case in which an eosinophilic granuloma of the long bone was discovered.

In many instances diagnosis will be established by biopsy of some accessible tissue, such as the lymph nodes. Biopsy of the liver may be helpful in the diagnosis of sarcoidosis; in the author's experience positive evidence has been obtained in about 70 per cent of the cases in which diagnosis seemed reasonably certain on other grounds. In polyarteritis nodosa, muscle biopsy is frequently performed, and in some diseases biopsy

of even macroscopically normal bronchial mucosa may give histologic evidence, as in lymphangitis carcinomatosa. In a few cases of sarcoidosis typical histologic changes were seen in a macroscopically normal bronchial mucosa.

The author describes at length the conditions which have particularly interested him, namely, chronic diffuse nodular fibrosis of the lungs, idiopathic pulmonary hemosiderosis, and polyarteritis nodosa affecting the lungs. His discussion of diffuse nodular fibrosis is based on 12 patients of middle age or older whom he observed in the past five years and covers fully the clinical, radiological, and pathological patterns. Five of the group have died, all of them from respiratory insufficiency. Idiopathic pulmonary hemosiderosis was first described in children, but the author observed a typical example of this syndrome in a woman whose symptoms started at the age of forty. Finally, polyarteritis nodosa and the different types of involvement of the lung encountered in these cases are considered.

Ten roentgenograms; 6 photomicrographs.

II. Gough considers the pulmonary aspects of pulmonary fibrosis, whether confined to the lungs or associated with systemic involvement of connective tissue, as in certain of the collagen diseases. He is not concerned with the more common fibrosis occurring in tuberculosis, unresolved pneumonia of pyogenic type, or with pulmonary collapse.

There are several different causes of fibrosis but the end-result may be similar, namely, a honeycomb lung, such as is seen in cases of eosinophilic xanthomatous granuloma and the chronic granuloma described by Cunningham and Parkinson (Thorax 5: 43, 1950). There may be associated proliferation of bronchial epithelium and smooth muscle, and in biopsies the former may be mistaken for malignant change. In Hamman and Rich fibrosis, dilatation of the air spaces is not marked.

In the collagen diseases some associated pulmonary changes are noted. Scleroderma is associated with two forms of fibrosis, cystic and solid. In lupus erythematosus the lung lesions are usually non-specific. In the classical form of periarteritis nodosa the lungs are seldom involved. Necrotizing arteritis in the lungs has been described, however, in several different conditions (infarctions and torsions; malignant hypertension; drug-induced vascular disease). In rheumatoid arthritis specific nodules have been found and diffuse fibrosis occurs occasionally. In coal miners there is a nodular condition which is a combination of infective pneumoconiosis and rheumatoid disease (Caplan's syndrome).

Two photomicrographs.

III. Lodge is concerned with the radiological changes in chests of patients suffering from the more common collagen diseases, namely, polyarteritis nodosa, acute lupus erythematosus, scleroderma, rheumatic fever and rheumatoid disease. He states that, given the right conditions, both fibrosis and changes in the pulmonary blood vessels and their effects can be demonstrated. The chest films may show a linear or reticular pattern, which in many cases appears to be of vascular origin. While it is not possible to say which of the lung vascular systems is mainly involved, it appears to be the pulmonary arterial system rather than the bronchial.

In polyarteritis nodosa one sees small consolida-

tions, increased vascular markings, mottling, pneumatoceles, and sometimes pleural effusions. These findings are often transitory in nature; they may be linked with eosinophilia and may disappear after cortisone treatment. In the terminal stages the so-called "batwing" shadow may be seen. In the author's experience pleural fluid is usually a terminal event and the "batwing" pattern is observed only when there is severe renal involvement.

Acute disseminated lupus erythematosus is a generalized disease of mesenchyme, and many systems may be affected, with or without facial lupus. One of the most constant features is polyserositis, and this also influences the chest findings. Mostly the lung changes are not specific but they tend to be basal in situation and irreversible. Generally in acute lupus erythematosus the changes may be in the form of pleural or pericardial effusions (usually small), subpleural consolidations, lobar consolidations of low density, and rarely a "vascular" pattern similar to that of polyarteritis. In 12 cases reviewed by the author there were obvious effusions in only 2 and small costophrenic shadows of doubtful significance in 3 others. Pneumonic consolidation was found in 2 patients and there were 3 examples of segmental collapse.

The author's impression is that lung changes in scleroderma are rather uncommon. Among 12 cases he demonstrated basal linear infiltration, chiefly on the right side, in only 4. A fibrocystic picture is also seen, some examples of which are referred to as "honey-comb" lung.

Rheumatoid fever and rheumatoid disease may give a radiographic pattern of basal reticulation, which in older people is steadily progressive. Lung changes of some kind were seen in only 9 of 40 cases reviewed by the author, but he feels that this is in no way a true representation of the incidence of lung shadows in rheumatoid disease, which is probably much lower. Pleural effusion is uncommon except when heart failure has supervened. In cases associated with coal miner's pneumoconiosis—so-called rheumatoid pneumoconiosis—the picture is specific, with multiple, round, well defined opacities distributed fairly evenly throughout the lungs, particularly at the periphery and in the middle and lower zones.

Twenty-seven roentgenograms.

JULIAN O. SALIK, M.D.  
Baltimore, Md.

**Intralobar Bronchopulmonary Sequestration.** C. Allen Wall and Joseph L. Lucido. *Surg., Gynec. & Obst.* 103: 701-707, December 1956. (J. L. L., 634 N. Grand Blvd., St. Louis 3, Mo.)

Bronchopulmonary sequestration is a dual anomaly of congenital origin. An anomalous vessel arising from the lower thoracic aorta pierces the inferior pulmonary ligament to enter the lower lobe, more often the left, there joining the segment of lung tissue which has partially or completely separated during the course of development from the normal bronchial tree.

The authors have found 94 cases in the literature, to which they add 6 of their own. Approximately 60 per cent of the patients have been males. Clinically, a history of recurrent pneumonic infection, often dating back to childhood, is more significant than the few moist râles or alteration in resonance in the lower lung field that may be elicited on examination.

The usual x-ray appearance of the sequestered lung

is that of chronic infection, with one or more thin-walled cysts containing fluid and air, usually located in the basal segments of the lower lobe. The ectopic lung may be demonstrable as a sharply outlined, rounded or triangular mass in the inferior portion of the lower lobe. The presence of long, branching, vertical lines directed toward the diaphragm suggests an anomalous vessel and this may be further demonstrated by laminagraphy (Landry and Salatch: *Arch. Surg.* 70: 411, 1955. *Abst. in Radiology* 66: 137, 1956). [Kenney and Eyler reported a case in which an aortogram showed the aberrant vessel. See *J.A.M.A.* 160: 1464, 1956. *Abst. in Radiology* 68: 281, 1957.—S. S.] Bronchography often reveals a filling defect or superior displacement of a lower lobe bronchus without opacification of the cystic structure.

Pathologically the separated lung tissue is rubbery, well demarcated from surrounding lung. Grossly the appearance is that of single to multiple cysts, localized bronchiectasis, or fetal lung which has never aerated. The neighboring bronchi may be dilated and infected but do not communicate with the cystic mass. The systemic vessel entering the segment is thickened by hypertrophy of the muscle bundles and an abundance of thick, uniform elastic fibers, making the structure quite unlike a pulmonary artery. The evidence suggests that it is primarily nutritive rather than a part of the oxygenating system. Venous drainage, however, is by way of the pulmonary veins.

The authors' 6 patients ranged in age from twenty months to fifty-five years. In 5 the anomalous vessel arose from the lower thoracic aorta; in the 6th its origin was traced to the upper abdominal aorta.

Two roentgenograms. SAUL SCHEFF, M.D.  
Boston, Mass.

**Bronchographic Studies as a Guide to the Surgical Treatment of Pulmonary Tuberculosis.** F. J. Phillips, Anthony Lalli, and Walther Buhler. *J. Thoracic Surg.* 32: 820-825, December 1956. (F. J. P., Seward Sanatorium, Bartlett, Alaska)

The importance and diagnostic value of bronchography in the surgical treatment of pulmonary tuberculosis is emphasized. At the Seward Sanatorium (Bartlett, Alaska) it has been found expedient to do bronchography almost routinely before any type of operative intervention. Normally, bronchography is preceded by bronchoscopy to effect cleansing, a 2 per cent solution of ephedrine sulfate in saline being injected through the bronchoscope as a mucosal astringent or bronchial dilator agent. Following bronchial aspiration, Iodochlorol is injected as a contrast medium through an ordinary urethral catheter inserted at the time of bronchoscopy.

In the past seven years, 276 bronchograms have been made, of which 240 were in patients with known tuberculosis. Bilateral lung involvement with some degree of bronchiectasis was found in 28.8 per cent, and unilateral bronchiectasis was found in 34.1 per cent of the cases.

In only 29 cases in the series was there obvious lower lobe involvement. This was at first surprising, but it is now considered not unusual for bronchiectasis to occur mainly in the upper lobes in pulmonary tuberculosis.

The authors state that "although in cases of bronchiectasis of nontuberculous type we are conservative in doing surgical resection . . . patients who have once had a sputum positive for acid-fast bacilli should have



the advantage of resection of the involved area, if feasible from the respiratory reserve evaluation."

Thirteen roentgenograms.

FRANK T. MORAN, M.D.  
Auburn, N. Y.

**The Solitary Pulmonary Nodule. A Ten-Year Study Based on 215 Cases.** Edgar W. Davis, J. Winthrop Peabody, Jr., and Sol Katz. *J. Thoracic Surg.* 32: 728-770, December 1956. (E. W. D., 1150 Connecticut Ave., N. W., Washington 6, D. C.)

An exhaustive study of the solitary pulmonary nodule has been made by the authors. Their survey includes a total of 215 patients upon whom they personally operated. The cases were selected in accordance with the following radiographic criteria:

1. The nodule must not exceed 6 cm. in diameter.
2. The nodule must be solitary, though small satellite lesions may be present.
3. It must lie within pulmonary parenchyma with aerated lung around it.
4. The shape must be round or ovoid.
5. The margins must be circumscribed and the contour smooth.
6. There must be no demonstrable calcium or cavitation within the nodule.
7. Associated pneumonitis, atelectasis, or regional lymphadenopathy, if present, must be minimal.

Of the 215 resected nodules, 47 per cent were malignant, 37 per cent being bronchial carcinomas. No sign was found sufficiently reliable to justify medical observation except calcification within the nodule. Since there have been appearing in the literature reports of the removal of malignant nodules containing calcium, the authors made a poll of the American Association for Thoracic Surgery and found the opinion evenly divided between those advising resection and those advocating observation of such lesions.

Among solitary nodules constituting the present series, bronchial carcinomas (79 cases) and granulomas (82) predominated. According to cell type, the most frequent were adenocarcinomas (36), including 9 bronchiolar carcinomas. There were 34 squamous carcinomas and 9 undifferentiated carcinomas. The end-results suggest that the adenocarcinomas and undifferentiated carcinomas have as favorable a prognosis as the squamous variety. The patient with a small solitary circumscribed asymptomatic bronchial carcinoma detected on a routine chest film has a 75 per cent chance of surviving five years if operated on promptly.

In practically every series of solitary pulmonary nodules, the most common single entity has been the granuloma. Thirty-eight per cent of the present series were granulomas. These nodules have been traditionally called "tuberculomas," on the basis of little more than gross appearance. In reviewing all of the tissue blocks of the solitary granulomas, it was found that 55 per cent contained *Histoplasma* and 7 per cent *Coccidioides*. In only 17 per cent could a tuberculous etiology be established.

The authors conclude that (1) every solitary, non-calcified pulmonary nodule demands thoracotomy; (2) for those with bronchial carcinoma, the absence of symptoms and promptness of surgery are apt to determine the chance for cure; (3) careful histologic study of the pulmonary granulomas will reveal the majority to be of fungal rather than tuberculous origin.

Forty-nine roentgenograms; 2 photomicrographs; 4 photographs; 4 graphs; 8 tables.

FRANK T. MORAN, M.D.  
Auburn, N. Y.

**Pleuropulmonary Amebiasis.** Albert C. Daniels and Max E. Childress. *California Med.* 85: 369-375, December 1956. (490 Post St., San Francisco 2, Calif.)

The common site of amebic abscess is the right lobe of the liver. In its progression this abscess may involve the right hemidiaphragm and by direct extension produce empyema, lung abscess, or bronchohepatic fistula. Rarely, the parasites may reach the chest by hematogenous or lymphatic routes, in which case a pulmonary abscess may develop with or without an associated liver abscess.

Following the formation of an amebic abscess in the liver, a 16 per cent incidence of pleuropulmonary involvement may be expected. The contents of a pulmonary abscess formed by direct extension have a characteristic "chocolate sauce" appearance and contain blood, cytolyzed liver tissue, and small solid particles of liver parenchyma. With secondary infection, the contents become purulent, with a resemblance to the hematogenous type of lung abscess.

The diagnosis is aided by a strong index of suspicion regarding any lesion in the lower right lung field of obscure etiology. Diaphragmatic involvement may produce symptoms simulating gallbladder disease; a dry cough may become productive, with the expectation of "chocolate sauce." Wasting may be severe and the presence of cachexia in association with a pulmonary lesion should suggest pulmonary amebiasis as well as tuberculosis or carcinoma. Physical signs of pleural fluid, consolidation, or abscess may be noted; often the liver is enlarged and tender. A mild leukocytosis is the rule.

Roentgenography may disclose elevation or fixation of the right hemidiaphragm. Pneumoperitoneum can be valuable in demonstrating a connection between the diaphragm and an underlying liver process. With pleural involvement, one sees the usual features of free fluid; parenchymal invasion is indicated by consolidation or an abscess cavity. Transient infiltrations, as noted in Loeffler's syndrome, have been described with pulmonary amebiasis. The discovery of cysts or trophozoites in the sputum, pleural exudate, or stool confirms the diagnosis, but the examination should be repeated several times on warmed specimens if initial studies are negative. Some clinicians believe that a positive complement-fixation test in the absence of demonstrable Amebae is indicative of extra-intestinal infection.

Ten cases of pleuropulmonary amebiasis are tabulated: 4 patients died, and in none of these was the correct diagnosis entertained or antiamebic therapy given. The response to specific drugs is gratifying. Although aspiration or excision of an abscess is probably not indicated, the disease is controlled satisfactorily by a course of antiamebic therapy following inadvertent surgery. In some obscure cases a therapeutic trial may be in order; pulmonary cavitation which persists after adequate therapy is probably coincidental and not related to amebic infection.

Three roentgenograms; 3 tables; 2 diagrams.

LAWRENCE A. POST, M.D.  
University of California, S. F.



**Unusual Fluoroscopic Findings Following Aspiration of Foreign Bodies.** H. Etter. Schweiz. med. Wchnschr. 86: 1394-1395, Dec. 8, 1956. (In German) (Röntgenabteilung Kantonsspital Luzern, Lucerne, Switzerland)

A case of aspiration of a non-opaque foreign body by a two-year-old child is reported. The foreign body was not seen in a bronchoscopic examination shortly after aspiration, nor was it demonstrable on roentgenograms obtained in inspiration. Fluoroscopic examination two weeks after the accident showed shift of the mediastinum and change in the appearance of the lung fields with inspiration and expiration. On a second bronchoscopy, the foreign body was found.

The author emphasizes the necessity of fluoroscopy in deep inspiration and expiration in cases in which non-opaque foreign body aspiration is suspected.

Three roentgenograms.

JULIUS HEYDEMANN, M.D.  
Chicago, Ill.

**Towards an Adequate Bronchography.** Otto H. Grunow and R. P. O'Bannon. Texas State J. Med. 52: 860-865, December 1956. (650 Fifth Ave., Fort Worth 3, Texas)

After a brief review of the history and technic of bronchography, the authors stress the following points:

1. The distressing retention of oily opaque media can be avoided by using a water-soluble medium, a suspension of propylidone, or a mixture of sulfanilamide and the oily medium of choice.

2. It is necessary that the examiner be well acquainted with the normal topography of the bronchial tree, and a complete examination of both lungs should be performed. Not only should the patient receive full value since he has been subjected to the discomfort as well as the risks of the procedure, but an incomplete bronchogram is frustrating to the physician who must make the diagnosis.

3. The healthy bronchus is not a passive tube but enters dynamically into respiratory activity and coughing.

4. The patient's interest must be protected by judgment in the choice of cases for this type of examination, in the method of anesthetization, protection from undue reactions, and adequacy of examination.

The authors describe their own technic, which is similar to many others.

**New Bronchographic Contrast Medium.** Sabino di Rienzo and Raúl Oscar Pereira Duarte. Radiologia 7: 9-11, December 1956. (In Spanish) (Escuela Privada de Radiología de Córdoba, Córdoba, Argentina)

The authors obtained satisfactory results from bronchography with a suspension of barium sulfate in carboxymethylcellulose (viscous base). The medium is very opaque, and most of it is eliminated at once (by expectoration), the remainder within forty-eight to seventy-two hours.

Four roentgenograms. E. R. N. GRIGG, M.D.  
Cook County Hospital, Chicago

**Hospital Admission X-Ray Program.** Sister Mary Joan Weissler. Illinois M. J. 110: 274-277, December 1956. (St. Clement's Hospital, Red Bud, Ill.)

The author believes a routine chest roentgen-ray program for hospitals should be strongly encouraged, since it is by such means that many cases of thoracic disease of various types are discovered. She describes

in detail the method of insuring the taking of 4 X 5-inch chest films in the program launched by St. Clement's Hospital, Red Bud, Ill., in July 1951. While 100 per cent coverage has not yet been achieved, at the present time only about 3 patients a month escape routine chest examination. Three cases are reported demonstrating the great advantages of the program.

**Ten Years Experience with Photofluorography in the Canton of Zurich.** M. Del Buono. Schweiz. med. Wchnschr. 86: 1364-1365, Dec. 1, 1956. (In German) (Röntgeninstitut und der Schirmbildzentrale des Kantonsspitals Zürich, Zurich, Switzerland)

In the ten years beginning with 1946, 709,868 people of all ages were examined photofluorographically in the Canton of Zurich. Of these 32 per cent were children, 41 per cent male adults, and 27 per cent female adults. Important findings were obtained in 0.3 per cent, relatively important findings in 3.3 per cent, and unimportant findings in 9.7 per cent of those examined. Two hundred and forty-two cases (0.04 per cent) of unknown active open tuberculosis were found, and 898 active but not open cases (0.12 per cent). One hundred malignant neoplasms were discovered.

Three tables. JULIUS HEYDEMANN, M.D.  
Chicago, Ill.

## THE HEART AND BLOOD VESSELS

**Hodgkin's Sarcoma Simulating Ventricular Aneurysm.** William O. Smith, Charles D. Tool, and James F. Hammarsten. Ann. Int. Med. 45: 1222-1228, December 1956. (J. F. H., VA Hospital, 921 N.E. 13th St., Oklahoma City, Okla.)

According to a number of reported autopsy series, infiltration of the myocardium by nests of malignant cells is not rare in Hodgkin's sarcoma, nor are small nodules on the pericardium. Large tumor nodules involving the heart, however, are uncommon. In the case reported here, in a man of sixty-three, there was massive involvement of the heart comprising all chambers except the right auricle, with a roentgen picture closely resembling a posterior ventricular aneurysm. It is of interest that no history of previous myocardial infarction was obtained and there had been no cardiac symptoms. Although primary T-wave changes were noted on the electrocardiogram, no ST segment shifts or QRS changes were seen.

In such a case as this the diagnosis of tumor involvement of the heart might be suspected antemortem by virtue of a negative cardiac history and absence of electrocardiographic findings indicative of previous infarction or ventricular aneurysm.

Six figures. STEPHEN N. TAGER, M.D.  
Evansville, Ind.

**Buckling of the Great Vessels. A Clinical and Angiocardiographic Study.** Irene Hsu and Albert D. Kistin. Arch. Int. Med. 98: 712-719, December 1956. (Department of Medicine, George Washington University School of Medicine, Washington, D. C.)

The authors report 16 cases of buckling of the great vessels to call attention to several aspects not previously mentioned and to re-emphasize that buckling is a benign condition and does not call for surgery. Buckling is usually due to arteriosclerotic tortuosity and kinking of one or more of the following arteries: innominate, right common carotid, right subclavian, and left common

carotid. It is often though not always associated with a widened uncoiled aorta.

Six patients in the present series had a pulsating mass at the base of the neck; 3, a pulsating mass bilaterally; 1, a pulsating mass confined to the left side of the neck; 2, a pulsating mass in the suprasternal notch; 2, a pulsating bulge in the right lateral wall of the posterior pharynx (in 1 there was also a pulsating mass at the base of the right side of the neck); 2, a widened superior mediastinum, with 1 showing calcification of the vessel wall at fluoroscopy.

The buckled vessels can be demonstrated by angiocardiology and, if need be, by direct carotid injection, thus permitting differentiation from aneurysm. Angiocardiography was carried out in 7 of the authors' cases. The roentgen findings are tabulated.

Clinical features of special interest were: (1) palpable left-sided buckling in the absence of its counterpart on the right; (2) tracheal deviation secondary to a buckled vessel; (3) two buckled vessels side by side, resulting in a large pulsating mass which suggested an aneurysm; (4) buckled right internal carotid artery (2 cases).

Four roentgenograms; 3 drawings.

**Kinking of Aortic Arch (Pseudocoarctation, Subclinical Coarctation).** André J. Bruwer and Howard B. Burchell. *J.A.M.A.* 162: 1445-1447, Dec. 15, 1956. (Mayo Clinic, Rochester, Minn.)

Aortic kinking refers to a congenital buckling of the aortic arch, without significant obstruction of the lumen, occurring at or near the insertion of the ligamentum arteriosum. The condition is probably entirely unrelated to true coarctation. The authors subscribe to the theory that the buckling deformity is the result of a short ligamentum arteriosum. The alteration of the course of the arch thereby produced may simulate aneurysm, mediastinal tumor, or coarctation, and result in an erroneous diagnosis unless the anomaly is recognized. A series of 10 cases of kinking of the aortic arch seen at the Mayo Clinic is described. Fewer than 30 such cases are said to have been reported.

The radiographic appearance takes two principal forms: (1) a biconvex aortic arch silhouette (the density of the upper portion being less than the lower); (2) a simple indentation in the descending arch. In the lateral or left anterior oblique projection the area of buckling is generally apparent, although in some cases angiocardiology may be necessary to outline the anomaly clearly and establish the diagnosis.

There are no physical findings or symptoms except for a precordial systolic murmur presumably produced by turbulence at the site of buckling.

Thirteen roentgenograms.

G. MELVIN STEVENS, M.D.  
Palo Alto, Calif.

**Pulmonary Arteriovenous Aneurysm in Childhood.** George S. Husson. *Pediatrics* 18: 871-879, December 1956. (Syracuse Memorial Hospital, Syracuse 10, N. Y.)

The author reports the case of a boy of two-and-a-half years, in whom a clinical diagnosis of pulmonary arteriovenous aneurysm was confirmed at operation. The patient was cyanotic and dyspneic, with clubbing of the fingers. Angiocardiography revealed many abnormal vessels in the inferior segments of the right upper lobe, especially in the pectoral and axillary areas.

The aorta was well visualized at two seconds, indicating a right-to-left shunt at the pulmonary artery and pulmonary vein level. The recognition of such cases, so amenable to surgery when the lesion is single, or even multiple, prevents their relegation to the realm of cyanotic heart disease, where more prolonged medical observation is the rule.

Roentgen examination may be diagnostic. The characteristic feature is the abnormal pulsating vascular shadow extending out from the hilus, decreasing in size with the Valsalva maneuver and increasing with the Müller. Small lesions may be hidden behind the cardiac shadow, and tomography or kymography may be required for their demonstration. Angiocardiography to delineate the extent, number, and size of the lesions should be undertaken in all cases prior to surgery.

Other conditions causing cyanosis, murmurs, clubbing, and dyspnea are to be differentiated. Mention is made of congenital cyanotic heart disease, polycythemia vera, chronic lung disease, and toxic states due to heavy metals and drugs.

Five roentgenograms; 2 photographs.

SAUL SCHEFF, M.D.  
Boston, Mass.

**Aorta-Pulmonary Artery Communication Through the Lungs. Report of a Case.** T. Sterling Claiborne and William A. Hopkins. *Circulation* 14: 1090-1092, December 1956. (Emory University School of Medicine, Atlanta, Ga.)

The authors report an unusual congenital anomaly in a girl of fourteen, consisting of a communication between the aorta and the pulmonary artery through a pulmonary vascular mass. There was a loud machinery-like murmur over the right side of the chest and the systemic pulse pressure was elevated. Cardiac catheterization demonstrated a high oxygen content of the right pulmonary artery, establishing the presence of a communication with the aorta. On angiocardiology, there was pooling of the medium in the right base medially. At surgery the entire right lower lobe appeared to be diffusely involved and was removed after ligation of the abnormal vessel through which the communication was effected. No sign of sequestered lung was found. Recovery was uneventful, with no further signs of cardiovascular abnormality.

Three roentgenograms. ZAC F. ENDRESS, M.D.  
Pontiac, Mich.

**The Abnormally Situated Azygos Vein. X-Ray Demonstration of Its Distention in Congestive Failure and in Various Positions.** Robert N. Armen and Charles S. Morrow. *Circulation* 14: 1079-1083, December 1956. (VA Hospital, Wilkes-Barre, Penna.)

The normally situated azygos vein is not easily recognized. The aberrant azygos vein, on the other hand, is readily seen on the postero-anterior chest film. A case is reported in which a distended aberrant azygos vein was demonstrated radiologically during periods of right heart failure. With recovery from failure, evidence of distention was no longer present on the erect view, but could still be visualized in the Trendelenburg and supine positions.

The authors conclude that right-sided heart failure may be identified by the demonstration of distention of an aberrant azygos vein.

Five roentgenograms. ZAC F. ENDRESS, M.D.  
Pontiac, Mich.

**The Vertebral Artery: Its Role in Upper Cervical and Head Pain.** Revis C. Lewis and Donald F. Coburn. *Missouri Med.* 53: 1059-1063, December 1956. (411 Nichols Road, Kansas City, Mo.)

In 11 patients with intractable pain in the head or upper cervical region, the authors were able to demonstrate constriction and/or partial or complete occlusion of the vertebral artery in different positions of the neck. They believe that the vertebral artery is sensitive to painful stimuli and that its compression by a hypertrophic spur or by angulation secondary to muscular spasm could produce head pain. It is felt, also, that such symptoms as dizziness, nausea, transient diplopia, and faintness may be due to temporary interference with circulation through one of the vertebral arteries, and that some of the symptoms following whiplash injury are attributable to at least partial occlusion of a vertebral artery either as a result of direct trauma to the artery or of secondary cervical muscle spasm. A possible connection of migraine with disturbance of vertebral arterial circulation and a consequent effect on the distal and temporal lobes is suggested.

Thirty-two roentgenograms.

**Aneurysm of the Renal Artery.** Samuel Malisoff and M. Cerruti. *J. Urol.* 76: 542-549, November 1956. (5 W. 86th St., New York 24, N. Y.)

Aneurysms of an artery are designated as "true" if the wall contains one or more layers of the artery and "false" if there has been rupture of a normal or diseased artery and the wall of the sac is formed by extravasated clotted blood and the surrounding tissues. Calcification is common in true aneurysms but rare in false aneurysms.

In the diagnosis of aneurysms of the renal artery, radiographic study is of first importance. Generally the sac appears as an incomplete circle of calcification, with a radiolucent center representing the lumen of the vessel. The kidney pelves or calyces may be deformed or displaced. A definite diagnosis is established only by aortography, which demonstrates the relationship of the mass to the renal artery and its branches and shows filling of the radiolucent center with the opaque medium. To be differentiated are calcified mesenteric lymph nodes, cholelithiasis, aneurysm of other vessels, renal lithiasis, tumor, tuberculosis, cysts, and hematomas of the kidney.

The authors present a single case report. The patient was examined for persistent pyuria. Intravenous urography demonstrated a ring-like calcification at the hilus of the right kidney. Aortography was not done. A right nephrectomy was performed and the pathologist's report confirmed the preoperative diagnosis of renal artery aneurysm.

Two roentgenograms; 2 photographs; 1 photomicrograph.

JOHN F. RIESSE, M.D.  
Springfield, Ohio

## THE DIGESTIVE SYSTEM

**The Value of Emergency Roentgenology in Acute Bleeding from the Upper Gastrointestinal Tract.** Elias Kredi Dabaj, Denio Odoardo Fonseca, Francisco Conde Otero, Joaquín Torres Cruz, and Rolando Perceiras Costa. *Radiología, Panamá* 7: 23-39, December 1956. (In Spanish) (Hospital Universitario, Havana, Cuba)

Within a period of three months the emergency room

of the University Hospital Garcia in Havana received 29 patients with acute bleeding from the upper gastrointestinal tract. All but 5 (2 who died in the emergency room, 2 who were immediately operated upon because of exsanguination, 1 for whom recent roentgenograms were available) were subjected to complete roentgen examination within twelve hours from the time of admission.

The examination included roentgenoscopy and compression spot-films with the patient upright and recumbent and the routine upper gastrointestinal views. The only contraindication to immediate roentgen study was a state of shock, in which event transfusion was first done. Indeed, liberal repletion prior to examination was considered one of the main reasons for absence of complications in the series.

Not only did the procedure seem to be practically innocuous, but its diagnostic efficiency reached satisfactory levels. Among 20 patients in whom a final diagnosis was obtained (some had more than one lesion), there were 10 duodenal ulcers (all correctly diagnosed), 8 gastric ulcers (6 recognized on roentgenologic examination, 1 on autopsy, 1 on gastroscopy), 4 cases of esophageal varices (all diagnosed), 1 gastric neoplasm (diagnosed), 1 duodenal diverticulum (diagnosed), and 1 case of erosive gastritis following gastrectomy (unrecognized roentgenologically, but diagnosed by gastroscopy). Thus, of 25 lesions, 22 (88 per cent) were accurately evaluated by roentgen examination.

Four tables.

E. R. N. GRIGG, M.D.  
Cook County Hospital

**The Roentgen Diagnosis of Pedunculated, Prolapsing Tumors of the Stomach.** Maurice Feldman. *Gastroenterology* 31: 758-763, December 1956. (3602 Fords Lane, Baltimore 15, Md.)

In a review of 1,319 adult autopsies, a single pedunculated tumor of the stomach was found. This was a calcifying fibroma which did not prolapse through the pyloric opening. In the author's clinical and roentgenologic experience he has seen only 4 cases of prolapsing pedunculated tumors of the stomach in which the diagnosis was substantiated at operation.

Pedunculated tumors may be of any histologic type, but most of them are benign growths—papillomatous, adenomatous, or inflammatory polyps. They most often arise in the mucosa near the pylorus or antrum. Although they may appear anywhere in the stomach, pedunculated prolapsing tumors rarely involve the cardia. Uncomplicated pedunculated benign tumors of the stomach may produce few or no symptoms, but sooner or later complications develop, such as ulceration and obstruction. Nausea, vomiting, melena, tarry stools, hematemesis, and anemia frequently occur. Pedunculated prolapsing benign tumors also have a tendency to become malignant.

Prolapsing gastric tumors present four characteristic roentgen signs: (1) a filling defect in the gastric wall, representing the pedicle attachment; (2) demonstration of the pedicle; (3) a small nodular filling defect in the duodenal bulb; (4) a widened pyloric channel and a collar-defect. In some instances a mucosal polyp may complicate the prolapse of gastric mucosa. In 1 of the author's 4 cases this was observed roentgenologically and confirmed surgically.

Six roentgenograms.

HOWARD L. STEINBACH, M.D.  
University of California, S. F.

**Neurogenic Neoplasms of the Stomach.** H. Schell-  
enberg. *Schweiz. med. Wchnschr.* 86: 1414-1417, Dec.  
15, 1956. (In German) (Krankenanstalt Neumünster,  
Zollikerberg/Zurich, Switzerland)

Neurogenic neoplasms (neuromas) of the stomach  
occur with varying frequency, but are relatively rare  
among benign gastric tumors. Most of them are very  
small and remain clinically latent. The predominant  
symptom is bleeding, encountered in 50 per cent of  
all cases. Dyspepsia and pain are less frequent as are  
nausea, slight weight loss and weakness, and "foetor ex  
ore." Mild hypochromic anemia is often present.  
Occasionally, the tumors are large, in which event they  
may be palpable.

Neuromas can arise from any portion of the stomach,  
but are somewhat more common in the prepyloric region  
on the lesser curvature side. They may be either endo-  
gastric or exogastric. They may originate from Auer-  
bach's plexus (multiform and fusiform neuromas) or  
from Meissner's plexus (neurofibromas). A roentgeno-  
gram usually shows a smooth-margined filling defect  
close to the stomach wall, which does not affect peri-  
stalsis. The tumor is often demonstrable only on com-  
pression films; the mass, protruding into the lumen of  
the stomach, is covered with normal mucosa; occa-  
sionally, an ulcer occurs on the adjacent mucous sur-  
face. A definite diagnosis is not possible roentgeno-  
graphically, since all extramucosal neoplasms produce  
similar findings.

The duration of symptoms is usually several years,  
since the tumors grow slowly. Occasionally, malignant  
change occurs.

The author reports a case of a neuroma in a forty-nine-  
year-old woman.

Two roentgenograms. JULIUS HEYDEMANN, M.D.  
Chicago, Ill.

**Primary Nonspecific Ulcers of the Small Intestine:  
Clinicopathologic Study of 18 Cases with Follow-up of  
14 Previously Reported Cases.** Carl G. Morlock,  
Homer R. Goehrs, and Malcolm B. Dockerty. *Gastro-  
enterology* 31: 667-680, December 1956. (Mayo  
Clinic, Rochester, Minn.)

Eighteen new cases of nonspecific jejuno-ileal ulcers  
are reported along with follow-up studies on a series of  
14 previously reviewed cases from the files of the Mayo  
Clinic (Evert *et al*: *Surgery* 23: 185, 1948). Thirteen of  
the new patients were males. The disease manifested  
itself by persistently recurring bouts of intermittent,  
crampy mid-abdominal pain in 16 of the 18 patients.  
The character and persistence of the pain usually indi-  
cated a diagnosis of partial obstruction of the small  
bowel. In the cases in which obstruction was most  
severe, vomiting occurred with considerable constancy.  
Symptoms and findings pointing to blood loss from the  
gastrointestinal tract were infrequent. In 3 patients  
initial complaints could have been interpreted as typi-  
cal for duodenal ulcer, but in only 1 of these was a duo-  
denal ulcer present.

Scout films of the abdomen gave useful information,  
demonstrating gas-filled loops of small intestine in 8  
instances. In 9 cases a thin suspension of barium sul-  
fate was introduced by mouth. In 3 of these no lesion  
of the small intestine was demonstrated. In the others  
it was possible to delineate the level of obstruction, and  
in 4 of this latter group the demonstration of a short  
stenosed segment of gut led the roentgenologist to ex-  
press the opinion that the obstruction was on an in-

flammatory basis. The diagnosis of "ulcer of the small  
intestine" was not once made roentgenographically in  
this group of patients.

In 12 of the patients the ulcers were localized to the  
ileum and in 6 they were jejunal. In 15 patients soli-  
tary ulcers were observed, and in the other 3, more than  
one ulcer was present. The lesions generally ranged  
from 0.3 to 4 cm. in diameter; 7 were large enough to  
merit the designation "annular." Associated peri-  
toneal reactions included 3 localized abscesses, 3 in-  
stances of nonsuppurative thickening of the mesentery,  
and 5 of localized peritonitis.

The etiology of these lesions is unknown. Possible  
relation to trauma, peptic and tryptic digestion, hetero-  
topic gastric mucosa, infection, and infarction have all  
been investigated with negative results.

Recommended therapy is surgical resection of the  
involved segment with entero-anastomosis. Prognosis  
is excellent; recurrences are rarely observed.

Six figures; 1 table.

HOWARD L. STEINBACH, M.D.  
University of California, S. F.

**An Evaluation of Cecal Size in Impending Perforation  
of the Cecum.** Robert M. Lowman and Leonard  
Davis. *Surg., Gynec. & Obst.* 103: 711-718, December  
1956. (Grace-New Haven Community Hospital, New  
Haven, Conn.)

This study of cecal size in impending perforation of  
the cecum is based largely upon the material dealt with  
somewhat more specifically by the authors in *RADI-  
OLOGY* (68: 542, 1957). They suggest a method based  
on roentgen measurement of the greatest transverse  
diameter of a distended cecum for diagnosis of a state  
of impending perforation. On this basis, surgery  
can be undertaken before perforation, resulting in a  
striking reduction in the immediate mortality rate.  
While the concept has been developed in a series of  
only 19 cases, the authors believe it deserves further ap-  
plication in view of the 75 per cent mortality consis-  
tently reported when surgery is delayed until perfora-  
tion has occurred.

Eight roentgenograms; 1 graph; 2 tables.

**Functional Diarrhea: An Analysis of the Clinical and  
Roentgen Manifestations.** M. H. Kalser, D. E. Zion,  
and H. L. Bockus. *Gastroenterology* 31: 629-646,  
December 1956. (H. L. B., 250 S. 18th St., Philadel-  
phia 3, Penna.)

Functional gastrointestinal disorders are the result of  
a disturbance of the normal physiologic activity of all or  
part of the gastrointestinal tract. Often the basic  
disturbance is overactivity of the normal control me-  
chanisms. Disturbances of the gastrointestinal tract  
also result from one or more irritable foci within the gut  
itself. Functional diarrhea due to allergy, and diarrhea  
which persists after antibiotic therapy or following acute  
infectious enteritis, depend in all likelihood upon the  
residual irritability of the intestinal mucosa. It is  
generally agreed that functional diarrhea of emotional  
origin is exceedingly common as a short-lived or brief  
episode. This article lends support to the thesis that  
chronic emotional diarrhea may persist for many weeks  
or months without respite.

The clinical and roentgen manifestations in 69 cases  
of functional diarrhea were analyzed. A second group  
of 29 patients with functional gastrointestinal disease  
but without diarrhea was used as a control. None of



these patients had laboratory or roentgen evidence of organic gastrointestinal disease. In the "diarrhea group" constipation alternated with diarrhea in 35 per cent; the diarrhea was continuous for many months or years in 11 per cent, and chronic diarrhea alternated with normal bowel habits in 54 per cent. Ninety-one per cent of the patients with diarrhea had abdominal pain, usually cramping in nature, located most often in the lower abdominal or periumbilical region. It was often relieved by defecation.

Roentgen studies of the small bowel in patients with functional diarrhea disclosed a striking increase in the incidence of hypermotility. When present to an extreme degree, this is almost pathognomonic of diarrhea of emotional origin. Coarsening of the jejunal mucosa was often noted. The ileum showed evidence of motor dysfunction more frequently than did the jejunum. Roentgen signs of irritability of the colon were present in the majority of patients with diarrhea as well as in those without this symptom.

Often the diagnosis of functional diarrhea will be justified by (1) absence of objective evidence of organic or constitutional disease; (2) absence of nutritional deficiency; (3) presence of emotional instability or emotional trauma; (4) signs of irritability and often of hypermotility of the small intestine on barium meal study.

Six roentgenograms; 2 charts; 6 tables.

HOWARD L. STEINBACH, M.D.  
University of California, S. F.

**Gastrointestinal Manifestations of Systemic Lupus Erythematosus.** Charles H. Brown, Earl K. Shirey, and John R. Haserick. *Gastroenterology* 31: 649-664, December 1956. (C. H. B., 2020 E. 93rd St., Cleveland 6, Ohio)

Although lupus erythematosus may be a progressive, ultimately fatal disease with diffuse systemic involvement, there have been few reports of its effect on the gastrointestinal tract. This article is based upon 87 patients with lupus erythematosus: 55 had no abdominal complaints; 25 had minor gastrointestinal symptoms, requiring only symptomatic treatment; 7 had severe gastrointestinal symptoms.

Five of the 7 patients with major symptoms had poor peristaltic activity in the upper gastrointestinal tract, with symptoms and signs suggestive of obstruction, although no obstructive lesions were present. These patients were considered to have an adynamic or paralytic ileus, for which no obvious cause could be found. The presence of the ileus was confirmed by roentgenography in each of the 5 (3 showed dilatation of the second and third portions of the duodenum, 1 a dilated atonic stomach, and 1 segmental dilatation of the jejunum) and additionally by surgery in 1. The ileus was temporary in all but one instance. In 1 patient an ulcer of the lesser curvature of the stomach developed. The etiology of the ileus in these 5 patients appeared to be related to the lupus erythematosus. Collagen deposition in the submucosa, vascular changes associated with primary disease, or a localized neurogenic phenomenon seemed the most likely explanation.

In 2 cases ulcerative colitis was associated with the lupus erythematosus. One of these patients had, also, severe liver disease with jaundice, spider nevi, a positive flocculation test, and increased prothrombin time that did not respond to vitamin K therapy. While the association of ulcerative colitis and lupus erythematosus is

unusual, the possibility that the two may be related must be considered. Investigation for the presence of lupus erythematosus is indicated in patients with atypical ulcerative colitis and in patients with systemic complications of ulcerative colitis.

Eight roentgenograms; 2 tables.

HOWARD L. STEINBACH, M.D.  
University of California, S. F.

**Recent Additions to Radiographic Techniques in Biliary Tract Disease.** Walter M. Whitehouse and Fred J. Hodges. *Gastroenterology* 31: 701-705, December 1956. (University Hospital, Ann Arbor, Mich.)

Many new technics have been developed for the diagnosis of biliary tract disease since the year 1950. Outstanding among the newer contrast media is Telepaque. It is the authors' continued opinion, after its routine use in over 8,000 examinations, that, in 2-gm. dosage, this is the oral cholecystographic medium of choice at the present time.

An analysis of 124 cases in which Telepaque cholecystograms were obtained before operation demonstrated that in general a decreasing density of the gallbladder shadow reflected an increasing severity of inflammatory changes in the wall, but that this rule could not be expected to hold with slight inflammatory change, nor could it be rigorously applied to any one case. The great majority of chronically infected gallbladders harbor stones and the stones, therefore, serve as an index of inflammatory change even though the gallbladder is well visualized.

The most significant advance in radiologic investigation of the biliary tract was the introduction of Cholografin for intravenous demonstration of the biliary duct system and gallbladder. An analysis of 88 cases revealed disappointing results in jaundiced patients, accounting for 14 of 27 failures of visualization. Fourteen cases with faint visualization showed the most frequent "liver battery test defects" in the cephalin flocculation, total serum bilirubin, and bromsulfalein retention, without a specific dividing line to differentiate them from the cases with "good" visualization, although the latter group in general showed fewer and less marked deviations from normal. The authors were able to demonstrate surgical anastomoses, a cholecystojejunostomy, a high choledochojejunostomy, and a choledochal cyst duodenostomy. A choledochal cyst was also visualized and the possibility of an intrahepatic biliary atresia was excluded by adequate filling of the gallbladder after intravenous injection.

Splenoportography has been used to demonstrate the varicosities secondary to portal hypertension and to establish or exclude an intrahepatic mass by the configuration of the adjacent portal venous branches. The presence of multiple metastatic masses can also be identified, and the attenuation of the vascular pattern and irregular opacification in cirrhosis may provide valuable confirmatory information.

HOWARD L. STEINBACH, M.D.  
University of California, S. F.

**Cholecystography with the Sodium Salt of Iopanoic Acid.** Rome Peterhoff. *Acta radiol.* 46: 719-722, December 1956. (University Hospital of Lund, Lund, Sweden)

Iopanoic acid ("Telepaque," "Bilijodon") has received widespread acceptance for oral cholecystography because of improved filling of the gallbladder and the



fewer and milder toxic reactions it elicits. It has, however, the disadvantage of low solubility, and unabsorbed medium in the intestine may at times cause difficulty in interpretation.

The sodium salt of iopanoic acid, Bilijodon Natrium, is much more soluble in the acid gastric juice, being broken down to produce an amorphous precipitate which is readily absorbed in the bowel. Even in the presence of achlorhydria the disintegration and subsequent absorption are complete.

Although animal experiments indicate that the toxicity of the sodium salt is roughly nine times that of the acid, clinical results show no such discrepancy. With a dose of 4 tablets (2.0 gm.) of the salt diarrhea occurred in 7 per cent of the patients; with higher dosage the incidence was increased—to 26 per cent with 6 and to 29 per cent with 12 tablets. Vomiting was not produced by 4 tablets, but with 6 tablets it was observed in 4.7 per cent of the patients, which is a higher incidence than with 6 tablets of Telepaque.

In 200 trials the percentage of visualization was the same for the sodium salt and the acid.

SAUL SCHEFF, M.D.  
Boston, Mass.

**Intravenous Cholangiography: Some Observations on the Use of Cholografin.** Worth A. Hooper and George Jacobson. *California Med.* 85: 389-393, December 1956. (1200 N. State St., Los Angeles 33, Calif.)

The authors relate their experience with Cholografin in post-cholecystectomy patients. Serial films are taken over a period of two hours following injection, and planigraphy is utilized when there is only faint visualization of the common duct or when confusing superimposed shadows are seen. One instance is cited in which an obstructed and dilated common duct was visualized only on a twenty-four-hour examination; therefore a routine twenty-four-hour film is taken if the ducts are not seen at the end of two hours.

In the presence of severe liver damage one can expect non-visualization, but the correlation with hepatic function is not exact, and non-visualization is occasionally encountered in patients with normal liver-function studies. It is felt that a common duct diameter greater than 15 mm. probably indicates obstruction.

In preoperative patients the authors question the value of Cholografin to demonstrate the gallbladder where an oral preparation fails; they prefer to reserve its use for those patients who cannot retain or absorb an oral medium, or where emergency operation is contemplated.

Seven roentgenograms. LAWRENCE A. POST, M.D.  
University of California, S. F.

**Cholegraphic Demonstration of Cystic Duct Obstruction.** P. Lőrinc and T. Herczeg. *Acta radiol.* 46: 723-730, December 1956. (State Institute for Postgraduate Medical Education, Budapest, Hungary)

The results of intravenous cholangiography with Biligrafin (Cholografin) in 102 patients in whom an oral medium failed to concentrate in the gallbladder are presented. In 10 patients the intravenous medium also showed insufficient concentration; in 60 the gallbladder was visualized; in the remaining 32 cystic duct obstruction was demonstrated.

Cystic duct obstruction is manifested by both direct and indirect signs. If the medium outlines the com-

mon bile ducts, with or without visualization of the hepatic radicles, and then passes for a distance along the cystic duct to terminate abruptly in a blunt, smooth, cap-like defect, this may be regarded as direct evidence of obstruction. It was observed in 17 of 72 cases. More commonly the sign of obstruction is indirect, the common bile duct filling without opacification of the cystic duct. The failure of the medium to progress into the cystic duct may be due to the presence of inspissated bile and/or mucus, scarring, stones, or tumor; rarely it is attributable to an internal gallbladder fistula or to aplasia of the gallbladder.

The authors suggest that the degree of common bile duct dilatation may be a function of the length of time that the cystic duct has been obstructed or surgically divided. They believe that the duct takes over the reservoir function of the occluded or extirpated gallbladder. The longer the period of cystic duct obstruction, the wider the common bile duct is likely to be. Thus, in 48 patients with a long history, the common bile duct was dilated (10 to 30 mm.) in 18; of 24 patients with a short history, only 2 showed common bile ducts larger than 10 mm. in diameter.

Whereas it has been contended that persistence of the medium in the common bile duct for over two hours is of pathological significance, indicating obstruction at the ampullary region, the present authors feel that such persistence may be merely a manifestation of the reservoir function in surgically or functionally cholecystectomized patients and that it is in itself inadequate evidence of disease in the common duct.

Seven roentgenograms. SAUL SCHEFF, M.D.  
Boston, Mass.

**Congenital Cystic Dilatation of the Common Bile Duct.** Juan Antonio Orfila, Emilio Chamboleyron, and Jacobo Sevilla. *Acta radiol. interam.* 6: 117-123, April-June 1956. (In Spanish) (J. A. O., Tiburcio Benegas 1248, Mendoza, Argentina)

The authors report a case of congenital dilatation of the common bile duct in a 19-year-old girl. The usual symptoms of pain, jaundice, and tumor were present. Roentgen studies were valuable in confirming the diagnosis of the cyst and an extensive cholecystoduodenostomy was successfully performed. The case was followed radiologically for three years, during which a constant reduction in size of the cyst occurred. The wide communication between the cyst and the duodenum did not result in any infectious phenomena in the bile ducts. The transparent greenish fluid obtained from the cyst did not produce the characteristic bile reactions. The patient is still well after three years and performs her duties as a housemaid without difficulty. She suffers only from transient diarrhea that is easily controlled by the usual measures.

Nine roentgenograms. JAMES T. CASE, M.D.  
Santa Barbara, Calif.

## THE MUSCULOSKELETAL SYSTEM

**Prenatal Injuries of the Skeleton.** J. Oehme. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 85: 671-674, December 1956. (In German) (Universitäts-Kinderklinik, Deutschhausstr. 12, Marburg/L., Germany)

Transverse lines of decreased bone density toward the ends of the long bones of growing infants are well known phenomena, along with the companion finding of double-contoured foot bones. These changes have

been ascribed to infection, defective nutrition, medication, heart disease, and birth injuries. Similar changes may be present at birth, obviously having occurred during the prenatal period. In the experience of the author, they are more apt to appear in children born to mothers suffering from diabetes or toxemia of pregnancy or undergoing intense arsenic or bismuth therapy. For this reason he has coined the term, enchondral embryopathy. To support his views, he notes that in 13 instances of blood group incompatibility between the mother and the child, 6 of the infants showed double-contoured foot bones at birth. In 22 cases of toxemia of pregnancy, 11 of the newborn showed both double-contoured foot bones and radiolucent lines in the long bones. In all cases, the radiolucent lines disappeared in the first three weeks of life and the double contour of the foot bones approximately five weeks later.

Other diseases known to produce these bone changes include diabetes, maternal diphtheria, and cytomegalic inclusion disease of the newborn. Radiolucent lines and double-contoured foot bones mean only that sometime during pregnancy the fetus has suffered damage.

Five roentgenograms.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Benign Osteopetrosis: Report of 9 Cases.** Arnold D. Platt, Gerald A. Erhard, and Jacob S. Araj. *Am. J. Roentgenol.* 76: 1119-1131, December 1956. (A. D. P., 36 W. Locust St., Newark, Ohio)

Osteopetrosis, or Albers-Schönberg disease, usually follows a malignant course in infants and children, in whom it has been most commonly described. In older patients it is asymptomatic, or mildly symptomatic, being found incidentally during roentgen examination for another condition. To this "benign" category, the authors add 9 cases.

The pathologic physiology of this disease is not clearly understood. The authors quote two articles which indicate that the disturbance in bone growth results from retarded resorption of the inner layers of the cortical bone, with consequent encroachment upon the marrow cavity.

Subjective symptoms were absent in over half of the author's patients and the disease was discovered in the course of a roentgen examination for some other reason. Roentgenologically the long bones show a lack of differentiation between the cortex and medulla, resulting in a homogeneous chalky density. In the skull, a similar homogeneous density is noted, with loss of the diploic spaces between the inner and outer tables. The base of the skull may be thickened, with encroachment on the cranial nerve foramina. The total dimensions, however, are not increased. The vertebrae may show a similar marble-like density. Another type of vertebral change consists in plate-like bony condensations at the upper and lower borders of the body, with a lucent zone situated horizontally across the middle, producing an appearance similar to that of infantile vertebrae. Carpal and tarsal bones may show concentric rings of dense bone surrounding a central clear zone.

To be considered in the differential diagnosis are Paget's disease, fluorosis, metastatic carcinoma (particularly from the prostate), osteomyelofibrosis, and diffuse chronic osteomyelitis (Garré's sclerosis).

Twenty roentgenograms.

D. D. ROSENFELD, M.D.  
Fontana, Calif.

**Hematogenous Osteomyelitis and the Segmental Bone Vessels.** H. Waschulewski. *Fortschr. a. d. Geb. d. Röntgenstrahlen* 85: 679-684, December 1956. (In German) (Universitätsinstitut für Röntgenologie und Radiologie der Charité, Berlin, Germany)

Whether or not the primary source of infection is known, hematogenous osteomyelitis is a manifestation of a septicemia, usually due to *Staphylococcus pyogenes aureus*. The onset, the clinical course, the severity, and the end-result are dependent upon such factors as virulence, body resistance, trauma, and antibiotic therapy rather than on anatomy. The precise location of the infection in the bone is, on the contrary, dependent upon the local anatomy and particularly, in the author's opinion, on the arterial distribution.

In the mild types of osteomyelitis which are seen today, the infection is prone to be in the diaphysis of a bone and is likely to be localized to the area of the segmental artery concerned. The segmental arteries under consideration in this connection are those other than the nutrient artery of the long bone. These are the arteries leaving the main arterial stem to supply the periosteum. Branches form half rings around the shaft of the bone and send further branches into the bone through the haversian canals. Terminal branches lie on the inner surface of the cavum medullae and in the region of the metaphyses.

In view of the anatomy of these segmental arteries, a hematogenous infection may be manifest first as a periostitis, second as a cortical form of osteomyelitis, and third as an intraosseous abscess. Among the cortical forms the author includes osteoid osteoma, which he believes to be an inflammatory lesion. Six cases are reported which illustrate the three possible levels of localization.

Eight roentgenograms.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Osteomyelitis Variolosa.** Robert W. Bertcher. *Am. J. Roentgenol.* 76: 1149-1153, December 1956. (195 N. Village Ave., Rockville Centre, N. Y.)

The author presents observations on 6 cases of osteomyelitis variolosa in Korean children. Three of these cases followed for several months are reported at some length.

Specific bone disease of variola is believed to result from invasion of bone at the time of the original viremia. The author's patients were seen about a month after the onset of smallpox. Involvement was limited to the elbows and knees and was invariably symmetrical bilaterally, although the clinical manifestations were often unilateral. As a rule, the entire bone was affected, with numerous irregular areas of destruction and resorption in the cortical and medullary portions. Extensive periosteal new bone formation along the shafts was noted. Mild para-articular soft-tissue swelling of the joints was usually present.

No specific therapy was given, and healing occurred despite malnutrition and intercurrent infectious diseases. Three-month follow-up films showed almost complete bone regeneration and resorption of periosteal new bone. Because of the short follow-up period, no observations on eventual deformity secondary to epiphyseal damage could be made.

In addition to the specific type of osteomyelitis described above, a suppurative form derived from hematogenous spread from pustular skin lesions may be seen.

The author saw 2 such cases, but these were not studied roentgenologically.

Twelve roentgenograms.

NORMAN L. ARNETT, M.D.  
Fontana, Calif.

**Osseous Coccidioidomycosis: A Chronic Form of Dissemination.** J. W. Birsner and Scott Smart. *Am. J. Roentgenol.* 76: 1052-1060, December 1956. (J. W. B., 1705 27th St., Bakersfield, Calif.)

The authors report a series of 18 cases, the first long-term follow-up study of osseous coccidioidomycosis to appear in the literature. These cases were followed for four to twenty-nine years. They are tabulated, and several brief case histories are included.

Bone involvement represents dissemination of coccidioidomycosis, which enters the body through the respiratory tract. Pulmonary lesions, however, are not invariably present, and soft-tissue swelling and bone lesions may be the initial symptoms.

The patients in the series reported here ranged in age from two weeks to fifty-six years at the onset of the disease. The interval from the earliest symptom to known bone involvement was from two weeks to eleven months. In 8 patients there was no sign of pulmonary disease at the time when osseous dissemination became evident. The sites of predilection were the distal portions of the extremities, bones of the trunk, and facial bones. Roentgenograms are reproduced to illustrate the bone changes. These demonstrate osteolysis with or without cortical thickening and sclerosis; the involvement was frequently in the medullary portion of the bone and is believed to be the result of hematogenous spread rather than of direct extension from the soft tissues. In 6 patients a single bone was involved; in 9, two bones; in 3, more than two bones.

There is no known medical treatment; surgical excision or amputation, when possible, has given favorable results. All but one of the authors' patients had returned to full activity.

Fourteen roentgenograms; 1 table.

JACK CARLISLE, M.D.  
Shreveport, La.

**Primary Vitamin-D Resistant Rickets. III. Biophysical Studies of Skeletal Tissue.** Bengt Engfeldt, R. Zetterström, and J. Winberg. *J. Bone & Joint Surg.* 38-A: 1323-1334, December 1956. (Karolinska Institutet, Stockholm, Sweden)

The pathogenesis of primary vitamin D-resistant rickets has remained obscure despite considerable interest and investigation of the disease in recent years. For study of the skeletal tissue characteristics, bone biopsy specimens were obtained from 4 patients with this disease.

The histologic findings in the specimens removed from the costochondral junction were suggestive of severe human rickets. Of interest is the fact that one section of compact bone (tibia) from a patient treated with large doses of vitamin D showed a pattern which was not consistent with rickets. The mosaic structure of this tibial specimen was reminiscent of Paget's disease.

The conclusions reached are that vitamin D-resistant rickets is a well defined clinical and pathological entity, different from ordinary rickets. Treatment with massive doses of vitamin D does not influence the morphology of the skeletal disorder and does not cure the disease.

Three roentgenograms; 8 microradiograms; 3 photomicrographs.

DEAN W. GEHEBER, M.D.  
Baton Rouge, La.

**Benign Chondroblastoma of Bone: Its Roentgen Diagnosis.** Robert S. Sherman and Ali Reha Uzel. *Am. J. Roentgenol.* 76: 1132-1140, December 1956. (444 E. 68th St., New York 21, N. Y.)

The authors present in detail the roentgen findings in 11 histologically proved cases of benign chondroblastomas of bone. One illustrative case is reported.

Although the authors' cases were about evenly divided between males and females, with an age range from nine to thirty-five years, the condition is more commonly found in males, with its highest incidence in adolescence, as the epiphyseal lines are closing. The humerus, femur, and tibia are most frequently involved, though lesions occur also in the small bones of the hand and foot. Clinically there is little to differentiate benign chondroblastoma from other bone tumors. Pain and swelling, together with limitation of motion, are common.

Roentgenologically, there is considerable variation in the relationship of the tumor to the epiphysis, but there is always some point of contact with the epiphyseal line. Five of the authors' cases showed varying degrees of involvement of both the epiphysis and metaphysis; 3 were confined to the epiphysis. The tumors were relatively constant in size and shape, being spherical and small (2.5 to 3.0 cm. in diameter). Characteristic bony changes are complete medullary destruction, fairly distinct borders, and flecks and strands of calcification within the area of destruction. The cortex may be slightly expanded and a soft-tissue mass may be present. Periosteal reaction of the buttress type may occur.

Lesions to be considered in the differential diagnosis are benign giant-cell tumor, enchondroma, osteogenic sarcoma, myeloma, and metastatic cancer. With the exception of atypical forms of giant-cell tumor, there is little difficulty in differentiation.

Twelve roentgenograms.

NORMAN L. ARNETT, M.D.  
Fontana, Calif.

**Osteoid Osteoma.** Robert A. Flaherty, David G. Pugh, and Malcolm B. Dockerty. *Am. J. Roentgenol.* 76: 1041-1051, December 1956. (Mayo Foundation, Rochester, Minn.)

Fifty-two cases of osteoid osteoma, many of which have been previously reported, are reviewed. The most frequent anatomic sites were the femur, tibia, other long bones, ilium and scapula. The age range was from two to fifty-two years, with only 2 patients over thirty-five. There were 11 females in the series.

Symptoms varied in duration from six months to six years, the average being less than one year. Pain was the most common symptom. It was aching in character, worse at night, and was relieved by aspirin. In cases in the proximal part of the femoral shaft or the femoral neck, the ilium, and scapula the pain simulated that associated with protruded intervertebral disk.

The chief physical sign was slight to moderate—occasionally exquisite—tenderness over the site of involvement. Swelling occurred when the lesion was close to the surface and limitation of motion when it was near the joint, with soft-tissue atrophy from disuse.

The natural history of the disease is unknown. In

view of the rarity of cases after thirty-five, it would seem that spontaneous regression may take place.

Grossly the tumor was shown to consist of red or red gray granular tissue, surrounded by dense white bone. Microscopic examination revealed a vascular fibrous tissue stroma with increased vascularity at the periphery. Large mesenchymal cells showing transition to fibroblasts and osteoblasts were noted, as well as giant osteoclasts and fine interlacing osteoid trabeculae. No bone marrow was present.

On the roentgenogram the tumor appears as an area of calcification with an irregular radiolucent center. Lesions in small bones with little periosteum show new bone formation. Erosion, expansion, or elevation of the cortex may occur. The most constant finding is cortical thickening. Lamination may occur in early cases.

To be differentiated are Garré's sclerosing osteitis, small Ewing tumor, osteogenic sarcoma, reticuloendotheliosis, march fracture, pyogenic abscess, osteomyelitis due to tuberculosis or brucellosis.

Nine roentgenograms; 2 photomicrographs; 2 tables.

JACK CARLISLE, M.D.  
Shreveport, La.

**Three Cases of Eosinophilic Granuloma of the Pelvis in Children.** Lorentz Nitter. *Acta radiol.* 46: 731-740, December 1956. (Norwegian Radium Hospital, Oslo, Norway)

The roentgen appearance of a sharply delimited round or oval osteolytic defect with no porotic or sclerotic border reaction, and usually no sequestration, is the familiar manifestation of eosinophilic granuloma. Systemic reaction, if present, is vague. Pain is usually localized to the lesion, which is wont to occur in the skull, vertebrae, pelvis, ribs, and anywhere along the three portions of the long bones. The condition occurs predominantly in childhood, although cases are reported in young adults. The lesions are solitary in two-thirds of the cases.

Three cases of iliac eosinophilic granuloma are reported in children of eighteen, twenty-four, and thirty months with histologic confirmation. In 2 cases where the treatment was primarily external irradiation, the lesions cleared by sclerosis. In the 1 where curettage was employed, new lesions appeared and, after an interval, those which had been curetted expanded. External irradiation finally arrested all the foci. Therapy in these children must be given with due regard for preservation of gonadal function.

Twelve roentgenograms; 1 drawing.

SAUL SCHEFF, M.D.  
Boston, Mass.

**Aneurysmal Bone Cyst.** Roland Guy, Odilon Raymond, Roger Samson, and J. Edouard Samson. *J. Canad. A. Radiologists* 7: 40-50, December 1956. (R. G., 411 Gouin Blvd. E., Montreal 12, Que., Canada)

The authors review the extensive literature relative to aneurysmal bone cysts and report 2 cases of their own.

Aneurysmal cysts represent about 1 per cent of all bone tumors. The long bones and the vertebrae are most often affected. The average age in 66 recorded cases was 17.9 years; there seems to be no sex predilection. The duration of symptoms, analyzed in 58 cases, was three months. A positive history of trauma was given by about 50 per cent of the patients.

The symptoms vary according to the location.

In a long bone the patient will notice slight persistent pain for a few weeks duration before a bony hard swelling develops. Once the lesion is apparent, the evolution is rapid. Exercise usually causes exacerbation of the pain. The mass is not fluctuating or pulsating and is attached to a bony structure.

In the long bones the diaphyseal end of the shaft is affected. In adults the epiphysis may be invaded, but never the articular cartilage. The lesion is cystic, distended, with a soap-bubble appearance on the roentgenogram. It is usually eccentric and involves only part of the width of the bone. In the flat bones there may be involvement of the whole width producing an elongated fusiform and almost symmetrical expansion. The cortex of the bone is often destroyed and the lesion is limited at its periphery by a thin shell of periosteal new bone. The mass is semiopaque and shows a honey-combed appearance with small trabeculae, the result of new bone formation. An erroneous diagnosis of osteogenic sarcoma may be made because of the destruction and new bone formation.

Histologically the lesion consists of vascular and connective tissues interspersed with blood lacunae of variable size. A constant and often predominant characteristic is the presence, in the midst of connective tissue trabeculae, of a primitive bone metaplasia, with formation of osteoid tissue. This bone metaplasia is relatively active everywhere but most so in the immediate vicinity of the blood channels. The overall histologic picture certainly shows no evidence of malignancy.

There exists considerable controversy as to the pathogenesis of this lesion. Most writers agree that it does not represent a true neoplasm. They accept it as a local vascular disturbance of the bone, the cause for which is still undetermined.

In the differential diagnosis, primary bone angioma, fibrous dysplasia or Jaffe-Lichtenstein's disease, osteogenic fibroma, giant-cell tumor, and solitary bone cyst must be considered. The roentgen differential diagnosis is discussed in some detail.

Three roentgenograms; ten photomicrographs; 3 tables.

JOHN P. FOTOPoulos, M.D.  
Hartford, Conn.

**Calcification of Articular Cartilage. Report of a Case.** Henry Bunjé and W. R. Cole. *J. Bone & Joint Surg.* 38-B: 874-881, November 1956. (University College Hospital, Jamaica, British West Indies)

A Jamaican woman of thirty-one with evidence of past gonococcal infection complained of intermittent joint pains for ten years. She was seen numerous times during that period for severe bouts of migratory pain. Only a few joints were involved at any one time, and the acute phases were transitory. A diagnosis of rheumatoid arthritis had been made and during the course of a year the patient had been treated with penicillin as well as several antiarthritic drugs and bed rest. Laboratory studies showed no significant abnormality. Radiographic examination demonstrated a thin calcific layer over the hyaline cartilage of the articular surfaces. The shoulders, elbows, hips, knees, ankles, wrists, and interphalangeal joints all showed this finding. Calcification was also present in the fibrocartilage disks of the symphysis pubis, knee, and ulnar-carpal joints.

The authors suggest that this calcium deposition is the result of repeated attacks of mild acute arthritis of



unknown etiology. The calcium apparently does not roughen the cartilaginous surface, as there are complete relief of symptoms and restoration of joint function during periods of remission without change in the radiographic appearance of the joints.

Fourteen roentgenograms; 2 tables.

NEIL E. CROW, M.D.  
Parks Air Force Base, Calif.

**Fragile Bones and Macrocranium.** Harry Bakwin and Marvin S. Eiger. *J. Pediat.* 49: 558-564, November 1956. (Department of Pediatrics, New York University College of Medicine, New York, N. Y.)

The case is described of a child with multiple fractures beginning in the first year of life, bowing of all four extremities, and a large head. Roentgen examination revealed greatly thickened frontal, parietal, and occipital bones with deepened diploic spaces, generalized osteoporosis, healing and healed fractures with bowing and angulation of all the long bones, and widening of the medullary cavities in the unfractured bones.

The long bone changes in this case resembled somewhat those seen in Paget's disease, but the skull changes were quite different. A diagnosis of an atypical form of osteogenesis imperfecta was favored by some, but two unusual features practically exclude this, namely, the widening of the medullary cavities in the unfractured bones and the great thickness of the calvarium.

[Keats, in a paper in *RADIOLOGY* 69: 408, 1957, referred to this report and expressed the opinion that calvarial thickening need not exclude a diagnosis of osteogenesis imperfecta. He reported a case with multiple fractures, diffuse thickening of the calvarium, and marked osteoporosis.—ED.]

Six roentgenograms; 2 photographs; 1 table.

**Discography.** Donald deForest Bauer. *M. Times* 84: 916-920, September 1956. (178 W. Commercial Ave., Coos Bay, Ore.)

The author discusses the shortcomings of myelography and the indications for discography in the diagnosis of intervertebral disk disease. Myelographic evidence, he states, is indirect evidence, produced by indentations on the Pantopaque column, whereas discography provides positive evidence of herniation or other disk abnormality. Discography should also increase our knowledge concerning poorly understood entities causing low back pain.

It is recommended that a negative myelogram be supplemented by discography prior to spinal fusion, since the operation will prevent further evaluation of the involved area by this procedure in the event symptoms should persist.

Eleven roentgenograms; 1 diagram.

RICHARD H. GREENSPAN, M.D.  
University of Minnesota

**Fractures of the Odontoid Process of the Axis.** N. J. Blockley and D. W. Purser. *J. Bone & Joint Surg.* 38-B: 794-817, November 1956. (D. W. P., Manchester Royal Infirmary, Manchester, England)

The authors analyzed 51 cases of fracture of the odontoid, including 11 cases not previously reported. They point out that odontoid fractures before and after the age of seven years differ and that fractures in the earlier age group are actually epiphyseal separations. These separations unite readily, and in cases of incomplete reduction, remodeling restores the normal anatomy of

the bone. In the older group non-union is quite common, having occurred in 22 of the 35 fractures of which the outcome is known. In many cases, however, there is a firm fibrous union. The adequacy of this can be determined by radiographs taken in full flexion and extension, which should show little or no movement at the fracture. Evidence of non-union can be obtained from anteroposterior views. In this event, rarefaction appears around the fracture after about three months; the fracture line may then appear wider and the opposed surfaces become well defined, with ultimate sclerosis. When bony union occurs, there is no ensheathing callus to be seen, nor is there any tendency for the odontoid to fuse with the anterior arch of the atlas.

The direction of displacement of the odontoid is related to the direction of the force of injury, forward displacement being twice as common as backward displacement. Immediate paralysis is more common in cases of backward displacement, but late neurological disorders were seen only after fractures with forward displacement. The authors utilize skull calipers for skeletal traction, which is maintained for six weeks, followed by six weeks of plaster immobilization. The caliper is incorporated in the plaster.

Twenty-six roentgenograms; 3 drawings; 1 chart; 9 tables.

BYRON G. BROGDON, M.D.  
Parks Air Force Base, Calif.

**Examination of the Atlanto-Axial Joint Following Injury with Particular Emphasis on Rotational Subluxation.** George Jacobson and Denis C. Adler. *Am. J. Roentgenol.* 76: 1081-1094, December 1956. (G. J., 1200 N. State St., Los Angeles 33, Calif.)

The atlanto-axial segment is unlike the remainder of the spine both anatomically and functionally. As a result, injury in the upper cervical region frequently results in fractures and dislocations which differ from those encountered elsewhere in the vertebral column. The authors are especially interested in rotational subluxation, an injury resulting in a disturbance of the rotatory motion of the atlanto-axial joint.

The atlanto-axial joint may be examined by (1) conventional roentgenography, (2) laminagraphy, and (3) motion or functional studies.

Two conventional open-mouth views, one with the central ray perpendicular to the joint and the other with the ray angulated 5° cephalad, are recommended. These may be supplemented by a "wagging-jaw" view, for which the patient moves the lower jaw as rapidly as possible to eliminate the overlying mandible. Two lateral views are also usually employed, one at 72 inches tube-film distance, with the tube centered in the mid-cervical region, and one at 36 inches closely coned and centered directly over the joint.

Laminagraphy may be indispensable in some cases. Laminagrams made in the anteroposterior projection are most useful for demonstration of fractures of the articular masses of the atlas and axis, the odontoid process, and the body of the axis. Lateral views will demonstrate fractures of the pedicles and neural arches.

Subluxations may occur which cannot be diagnosed by the usual static roentgen examination. For such cases special studies to evaluate the degree of rotation may be required. The author uses three sets of laminagrams at 8 to 12-cm. levels, one with the head in the sagittal plane and one each with symmetrical rotation of the head approximately 45° to the right and to the left. The quality of the laminagrams is slightly im-



proved by wagging of the jaw. Some authors have used plane films for similar functional studies.

Four cases are presented showing rotational subluxation characterized by medial displacement of one articular mass of the atlas with respect to the corresponding mass of the axis and by abnormal rotatory motion of the atlanto-axial joint.

Thirty-four roentgenograms; 8 drawings.

JACK CARLISLE, M.D.  
Shreveport, La.

#### The Frequency of Osteochondritic Roentgen Findings of the Cervical Spine in 400 Symptom-Free Adults.

H.-J. Tepe. Fortschr. a. d. Geb. d. Röntgenstrahlen 85: 659-663, December 1956. (In German) (Hohnerkamp 89, Hamburg-Bramfeld, Germany)

With increased interest in the cervical spine as the source of such syndromes as cervical migraine, shoulder-arm pain, neck pain, and circulatory disturbances, the actual significance of degenerative changes as seen on the routine roentgenogram must be carefully evaluated. A major question is the incidence of osteochondrosis in the symptom-free individual over forty years of age. To determine this, 400 patients, 203 male and 197 female, were radiographed upright in the lateral projection only. All were questioned in regard to previous cervical spine abnormality. None gave a history of headache, arm pain, shoulder pain, or symptoms of any type referable to the cervical area.

In 63.5 per cent of the series the spine showed degenerative changes, with a slightly higher incidence in the female (131) than in the male (123). As might be expected, the frequency paralleled age: in the fourth decade osteochondrosis was found in 29 per cent. This figure rose to 63 per cent in the fifth, 69 per cent in the sixth, 89 per cent in the seventh, and 94 per cent in the eighth decade.

In the course of the study, postural anomalies were also tabulated but the findings here were far less reliable. The average male, when told to lower his shoulders for a radiograph, is apt to straighten the cervical spine. Such a roentgenogram will be reported as showing straightening of the normal curvature. Fluoroscopy of these individuals, however, shows normal mobility of the spine. If variations in cervical alignment were reported along with degenerative changes, only 17 per cent of the cervical spines in the present series would be considered normal.

Five tables.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Pre-Employment Roentgenograms of the Lower Dorsal and Lumbosacral Spine in Young Men.** Rolf M. Iverson. Minnesota Med. 39: 771-774, December 1956. (78 S. Ninth St., Minneapolis 2, Minn.)

Between 1940 and 1950, Ohio had an increase in employment of 31 per cent, while back injuries rose 132 per cent. Other states have had similar experiences. In an attempt to evaluate the contribution of pre-employment roentgen examination of the lumbosacral spine to the prevention of such injuries, the author quotes extensively from Becker's reports of the experience of the Western Electric Company in Chicago (Indust. Med. & Surg. 22: 8, 1953; 24: 486, 1955). As a result of a program designed to place workers in physically compatible jobs, 2,240 (73 per cent) of 3,074 men examined for heavy work were accepted and 834 (27 per cent) were declared unfit. On reviewing all

injuries for four years before and five years after establishing this program, the company found a decline of 67 per cent in the number of disabling back injuries and an abrupt decline in the severity rate. In 1944 there were one hundred and twenty-two days lost per 1,000 shop men; in 1952, nineteen; in 1953, eighteen; and in 1954, five.

The author obtained routine lumbosacral spine roentgenograms, including the lower 2 dorsal vertebrae, for 232 applicants for hazardous work on the Great Northern Railroad, and for 170 applicants on the Milwaukee Railroad. In the latter group, additional views of the lower half of the dorsal spine and pelvis and a special anteroposterior view of the lumbosacral joint with the tube angled 35° toward the head were made. On the Great Northern Road there were 40 "probable rejects." Results for the Milwaukee were not available.

On the basis of his observations, the author concludes that about 50 per cent of symptomless young men will show anomalies, structural variants, or residual pathologic or traumatic lesions. He attempts to classify these findings on a realistic basis, to determine which abnormalities indicate a potential hazard. While he feels that the majority of his findings are too minor or of too frequent occurrence to be regarded as significant, they should be available for comparative purposes in the event of future trauma. If used properly by doctors, lawyers, employers and employees, such records may in time establish a valuable "base line of 'fair play' for both the employee and the employer."

**Myelography in the Lumbar Region with Water-Soluble Contrast Medium.** Th. Boesman. J. Bone & Joint Surg. 38-B: 882-883, November 1956. (Annakliniek, Leiden, Holland)

The author reports that 90 myelographic studies have been done with "Leo U," a 20 per cent solution of sodium monoiodomethanesulphonate; 73 cases have been observed long enough to give an impression as to the value of this method.

The patient is positioned on the side, with the head of the table tilted up 20°. The spinal canal is entered with a fine needle at the L3-L4 interspace, the pressure is measured, 10 c.c. of cerebrospinal fluid is removed for examination, and 1.5 c.c. of 10 per cent aethocaine is injected. Fifteen minutes later 15 c.c. of "Leo U" is introduced, the needle being left in place. Four films are obtained with the tube directed horizontally and the patient lying on the side on which the lesion is suspected, rotated 30° forward, rotated 45° backward, and prone. Ten cubic centimeters of fluid are subsequently withdrawn. The patient is instructed to rest for two hours, "half-sitting in bed," and then remains flat in bed for twenty-four hours. No serious ill effects are reported.

In 26 cases the myelographic and operative findings were positive. In 3 cases the results of myelography were doubtful but the operative findings were positive. In 1 case both the myelogram and the operative findings were negative. In 3 cases myelography was negative but the operative findings were positive. In 40 cases without operation, there was complete conformity between the clinical and the myelographic findings in 22 cases. In 15 cases in which the myelographic findings were doubtful, conservative therapy permitted return of the patients to a normal work load.

Two roentgenograms.

NEIL E. CROW, M.D.  
Parks Air Force Base, Calif.

**Secondary Ossification Centers and the Intra-Articular Ossicle.** Lee A. Hadley. *Am. J. Roentgenol.* **76**: 1095-1101, December 1956. (925 State Tower Bldg., Syracuse 2, N. Y.)

Secondary ossification centers appear as small epiphyses at the tips of the spinous transverse and articular processes early in the second decade. In a large series of spinal roentgenograms, the incidence was found to be 1.5 per cent (Farmer: *Am. J. Roentgenol.* **36**: 763, 1936. *Abst. in Radiology* **30**: 270, 1938). The second and third lumbar vertebrae are the most frequent sites. Incompletely united ossification centers may show a notching on the medial side of the inferior articular process. Multiple small ossicles may appear in the place of the ununited center.

Persistent ossification centers may be traumatized, as by a fall, in which case the patient may complain of localized pain as in a fracture of the inferior articular process. In such cases the roentgenogram will demonstrate the ossicles as separate structures.

The author describes also an ununited ossification center at the tip of the odontoid; intra-articular ossicles, which may force the articular processes apart, widening the posterior joint space; and the so-called limbus bone, appearing as a triangular shadow at the upper or lower anterior corner of the vertebra.

Fourteen roentgenograms; 1 photograph.

JACK CARLISLE, M.D.  
Shreveport, La.

**Variations and Anomalies of the Sternum, Together with a Study of Their Development.** Kl. Pfeiffer. *Fortschr. a. d. Geb. d. Röntgenstrahlen* **85**: 663-671, December 1956. (In German) (Universitäts-Röntgeninstitut Leipzig, Leipzig, Germany)

Eight cases are reported by the author illustrating abnormalities of the sternoclavicular joint, the manubrium sterni, and the corpus sterni. One case in the first division is of interest: that of a seventeen-year-old male, in whom the sternal ends of both clavicles were forked much like the ends of a bifurcated rib. Under disorders of the manubrium, the discussion centers upon the os parasternale, with reports of 2 cases.

The author considers the small three-cornered ossicles located at the lower margin of the sternoclavicular joints as intimately a part of the sternum. This is in disagreement with Köhler, who regarded them as a portion of the first rib. Peristernal ossicles are not uncommon, but are usually overlooked or not mentioned in reports on ordinary chest films. When fused with the manubrium, these ossicles form parasternal processes. While the manubrium arises from a single ossification center, the gladiolus arises from many. Despite the multiplicity of its origin, anomalies are uncommon. Multiple ossification centers for the sternum, of which seven were readily visible, were seen in siblings of two and four years. The final case reported is one of congenital absence of the gladiolus.

Fifteen roentgenograms; 1 photograph; 2 diagrams.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Persistent Epiphyses at the Elbow Joint.** L. Sieckel. *Fortschr. a. d. Geb. d. Röntgenstrahlen* **85**: 709-716, December 1956. (In German) (Röntgen- und Radium-Abteilung des Knappschafts-Krankenhauses Recklinghausen, Recklinghausen, Germany)

Early radiologists and anatomists emphasize the

rarity of para-articular ossifications at the elbow. In addition to the classic report in the Zimmer-Köhler text (*Grenzen des Normalen und Anfänge des Pathologischen im Röntgenbilde des Skelettes*. Stuttgart, Georg Thieme, 9th ed., 1953), the author found 22 contributions relative to accessory ossicles at the elbow joint. He himself radiographed 500 normal elbows in which there was no history of injury and found 22 examples of persistent epiphyses at the medial humeral epicondyle, an incidence of 3.7 per cent. In 3 of the 22 cases the accessory bones followed a familial pattern. Other joint disturbances, including persistent olecranon epiphyses, foramen trochleare, Osgood-Schlatter's disease, and loose bodies in the elbow joint, as well as in other joints, were demonstrated in 10 of the cases.

The differential problem is chiefly that of distinguishing between a fracture, whether old or recent, and a normal developmental variant. Both the history and the roentgen interpretation are important. With care, a recent fracture may be readily recognized. For many years all ossicles in this region were considered the result of an old fracture or possibly a childhood separation of the epiphyses for the epicondyle. Present evidence is against a factor of trauma in many of the cases. There is much doubt as to relationship of this bone formation to occupation, particularly to pneumatic drill operation. In the absence of a specific history of trauma, the author considers most cases of excessory ossicles at the elbow as a slight developmental anomaly.

Nineteen roentgenograms; 1 table.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Hypertrophic Osteoarthropathy.** Morton Shapiro. *Arch. Int. Med.* **98**: 700-711, December 1956. (VA Hospital, Long Beach, Calif.)

Hypertrophic osteoarthropathy is defined as a chronic proliferative superiosteal osteitis involving the distal ends of the extremities, manifested by clubbing of the fingers, swelling, pain, tenderness, and accompanying joint disorders. It is thought that it represents an extension of the process of clubbing, the related lesions developing secondary to the same general group of conditions, most commonly chronic pulmonary, pleural, or mediastinal disease. Six cases are reported to illustrate the various clinical and roentgenologic manifestations of hypertrophic osteoarthropathy secondary to bronchogenic carcinoma.

The early lesion of osteoarthropathy may produce no symptoms, but as the condition progresses, severe bone pain and tenderness are present along the shafts of the long bones. Acute joint manifestations are common, and most cases have been incorrectly diagnosed as rheumatoid arthritis. Even though the crippling has been present for long periods, surgical removal or radiation therapy of the lung cancer results in a dramatic amelioration of symptoms.

In the early stages of clubbing no changes may be visible roentgenographically, but as the condition continues an increased flare of the ungual process may be visible. As a result of uneven calcification of the new bone, the periosteum is irregularly raised, and its outline may appear serrated. With exacerbations and remissions of the underlying disease, the new bone may be laid down in thin sheets, producing a tree-trunk layering effect. In the later stages, osteoporosis of the cancellous portion and thinning of the original bony cortex may be observed.

Although hypertrophic osteoarthropathy occurs in only about 5 per cent of the cases of bronchogenic carcinoma, it may provide the clinician with the earliest clue to the detection of the pulmonary neoplasm, many times long before the tumor is visible on the roentgenogram. Prompt recognition of the syndrome may result in early diagnosis and more successful treatment of a certain percentage of cases.

Seven roentgenograms.

**Studies of the Hip Joint by Means of Lateral Acetabular Roentgenograms.** Knox Dunlap, Alfred B. Swanson, and Ralph S. Penner. *J. Bone & Joint Surg.* 38-A: 1218-1230, December 1956. (Madigan Army Hospital, Fort Lewis, Wash.)

The authors studied 400 normal and abnormal hip joints by means of lateral acetabular roentgenograms. For these, the patient was seated with the thighs together and flexed 90°. The Bucky diaphragm was so placed that the film was at right angles to and centered beneath the patient's midline. The tube, with an extension cylinder, was centered over the iliac crest and tilted to form an angle of 30° with the long axis of the body. Roentgenograms were made of each acetabulum without change in position and it was thus possible to reconstruct a superior-inferior image of the pelvis. Anteroposterior views were also made of the pelvis to determine the width in the reconstruction.

It was found that in the average adult the plane of the acetabulum formed an angle of 35° with the sagittal plane of the body. In children, the average figure for this angle was 32°. It was also found that there was practically no variation in the forward obliquity of the acetabulum in children of different ages. No conclusions were drawn as to the relationship of the anterior obliquity of the acetabulum and congenital dislocation of the hip.

The authors present reports of 5 cases in which the lateral roentgenogram of the acetabulum was of value in arriving at a correct diagnosis or in facilitating treatment.

Nineteen roentgenograms; 2 photographs; 4 charts; 1 diagram.

DEAN W. GEHEBER, M.D.  
Baton Rouge, La.

**Thyroid Function in Legg-Perthes Disease.** D. D. Beiler and W. H. Love. *J. Bone & Joint Surg.* 38-A: 1320-1322, December 1956. (George F. Geisinger Memorial Hospital, Danville, Penna.)

The theory that Legg-Perthes disease is associated with hormonal imbalance, particularly hypothyroidism, has been widely accepted. In 1943, careful investigation of 20 patients with Legg-Perthes disease disclosed no evidence of hypothyroidism (Gill: *J. Bone & Joint Surg.* 25: 892, 1943). The accuracy of measurement of thyroid function has, however, been greatly improved with the use of the tests involving radioactive iodine and the chemical determination of the serum protein-bound iodine. With this in mind, the authors undertook a study of 10 patients with unilateral Legg-Perthes disease. Clinical examinations, serum protein-bound iodine determinations, and thyroid uptake studies were carried out, supplemented in 7 cases by determination of iodine concentration in the saliva.

There was no evidence of hypothyroidism in any instance. Two patients showed asymmetry of radioactive-iodine uptake in the thyroid gland, and the possibility of a hyper-functioning adenoma in these 2 pa-

tients cannot be excluded. The overall thyroid function, however, was normal.

One table.

DEAN W. GEHEBER, M.D.  
Baton Rouge, La.

**Calculation of the Angle of Anteversion by Means of Horizontal Lateral Roentgenography.** Donald J. Magilligan. *J. Bone & Joint Surg.* 38-A: 1231-1246, December 1956. (284 Garfield Place, Brooklyn 15, N.Y.)

The femoral neck projects away from the shaft in a direction which can be defined by two angles: the angle of lateral deviation, designated as the cervicofemoral angle, and the angle of anteversion or anterior projection. The true angle of anteversion can be separated from the cervicofemoral angle and projected onto a film as a single angle by directing an x-ray beam through the long axis of the femur onto a cassette held perpendicular to it. This has been tried but is technically unsatisfactory. Roentgen visualization of the femur in any other position would necessarily produce a projected cervicofemoral angle and a projected angle of anteversion. Neither of these represents the true value of the angle. However, with the use of the two projected angles, the true angle of anteversion can be calculated by means of a trigonometric formula.

The author's method, based on this principle, utilizes anteroposterior and horizontal lateral roentgenograms. For obtaining the anteroposterior film it is essential that the femur be parallel to the table and in the neutral position. In obtaining the horizontal lateral roentgenogram the cassette is held against the lateral side of the thigh and trunk, and the x-ray tube is placed between the legs. The two projected angles thus obtained can be used to calculate the true angle of anteversion by means of a mathematical formula, as described in the paper.

This method compares favorably as to accuracy with others based on the same principle. Its chief merit is that the calculations can be made from roentgenograms already obtained for determining the relation of the femoral head to the acetabulum.

Twenty roentgenograms; 6 photographs; 4 drawings; 3 tables.

DEAN W. GEHEBER, M.D.  
Baton Rouge, La.

**Fracture Dislocation of the Ankle with Fixed Displacement of the Fibula Behind the Tibia.** John J. Fahey, Leo T. Schlenker, and Richard C. Stauffer. *Am. J. Roentgenol.* 76: 1102-1113, December 1956. (J. J. F., 1791 W. Howard St., Chicago 26, Ill.)

The authors report 3 cases of a condition originally described by Bosworth (*J. Bone & Joint Surg.* 29: 130, 1947), in which the distal fibula is fractured and the lower edge of the upper fibular fragment is fixed behind the posterolateral edge of the tibia. Open reduction is necessary in all cases because the upper fibular fragment is firmly lodged in the intact interosseous membrane and during closed manipulation cannot be forced back over the posterolateral ridge of the lower tibia to its normal position. Recognition of this syndrome will prevent unnecessary manipulation, thus reducing trauma to an already traumatized ankle joint.

The diagnosis can be made by roentgenograms taken in true anteroposterior and lateral positions. In the normal ankle, in the anteroposterior view, there is only a small overlap of the tibia on the fibula, while in the lateral view the fibula and tibia show obvious overlap.

In this type of injury, aside from the astragalar dislocation, there is an overlap of the fibula on the tibia in the anteroposterior view; while in the lateral view the proximal fibular fragment is displaced posterior to the tibia. The superimposition on the anteroposterior view and the posterior displacement on the lateral view may, if minimal, be mistakenly attributed to oblique positioning and the condition may not be recognized.

Twenty-nine roentgenograms provide an excellent demonstration of the normal and abnormal appearances in the articulated tibia and fibula.

D. D. ROSENFELD, M.D.  
Fontana, Calif.

### GYNECOLOGY AND OBSTETRICS

**The Diagnosis of Submucous Fibroids by Hystero-graphy.** Samuel Rozin. *J. Obst. & Gynaec. Brit. Emp.* 63: 917-919, December 1956. (Department of Gynecology & Obstetrics, Rothschild Hadassah University Hospital, Jerusalem, Israel)

Hystero-graphy is one of the most valuable procedures for detecting uterine fibroids, especially those of the submucous variety. The technic employed by the authors consists in the initial injection of 1.0-1.5 ml. of contrast medium. In enlarged uterine cavities further injections of the same amount are made, roentgenograms being taken after every injection until visualization of the tubes indicates a completely filled cavity. Excessive amounts of medium may overshadow intra-uterine defects. Oblique views should always be taken as soon as there is evidence of tubal filling, as they give additional information concerning the size and position of the tumor. Further information may be obtained from evacuation (decompression) films taken immediately, at two minutes, and at five to ten minutes after removal of the cannula. These roentgenograms are of special value in patients in whom the cavity was over-distended with contrast material, partly or completely obscuring filling defects.

In the presence of submucous fibroids, the uterine cavity may show slight enlargement and distention, or none at all, depending upon the size of the tumor. When the tumor is small, the original triangular shape of the uterus may be maintained to a greater or lesser degree. Large tumors distort the cavity, causing it to assume a globular, crescentic, or spindle shape. A single nodule produces a characteristic image—a smooth, rounded, clean-cut filling defect, which may reach the size of an egg.

Multiple submucous fibroids, located in different parts of the uterine cavity, may produce separate round filling defects. Or the filling defect produced by a large fibroid occupying the major part of the cavity may mask defects produced by smaller tumors.

When the tumor is sessile, its attachment to the uterine wall is characterized by a broad interruption in the outline of the uterine cavity. The filling defect has the more or less regular appearance of a segment of a sphere, incompletely surrounded by contrast medium.

Pedunculated fibroids produce a lacunar image occupying nearly the whole of an enlarged globular uterus. In some cases, dilatation of the isthmus is also seen. The lacunar image is apparent in all views, anteroposterior as well as oblique.

A pedunculated submucous fibroid descending into the cervical canal dilates and elongates the cervix. The filling defect, usually large and globular and occupy-

ing the whole or a part of the canal, is easily distinguishable from a cervical polyp by its smooth and circular appearance.

Endometrial polyps, in contrast to submucous fibroids, are of irregular shape with an uneven surface and accommodate their growth to the uterine cavity. Difficulty may be encountered in differentiating between a pedunculated fibroid and a large polyp, since in both instances the filling defect usually occupies a central position. In general, polyps are elongated, while pedunculated fibroids are circular.

The transitional form of an intramural fibroid which is developing toward the cavity does not generally exhibit the characteristic filling defects seen in submucous fibroids. It produces a pressure defect which only causes contrasts in the density of the shadow of the cavity. In many instances, the differential diagnosis is impossible.

Air injected with the oil may produce defects simulating small submucous fibroids. Air bubbles, however, usually change shape and position in subsequent films or may disappear completely when additional contrast medium is introduced.

Carcinoma of the corpus is generally characterized by a limited filling defect whose outline is more or less irregular and fimbriated. Placental fragments also produce irregular and fimbriated outlines which may be confused with those due to carcinoma. The diagnosis can be made by curettage.

Six hystero-graphs.

**The Hystero-graph in the Study of Sterility.** Samuel Norris. *Canad. M. A. J.* 75: 1016-1020, Dec. 15, 1956. (158 St. George St., Toronto, Canada)

A series of 961 sterility studies with the aid of hystero-graphy, between 1940 and 1953, is reported from the New Mt. Sinai Hospital of Toronto. In 233 women (24.2 per cent) pregnancy was attained after the procedure. There were 273 known pregnancies; 21 of these (7.67 per cent) ended in miscarriage before the fourth month. Four ectopic pregnancies occurred (1.17 per cent), but 2 of these were in women who had a history of previous ectopic pregnancy. One of these bore a full-term baby before suffering her second ectopic pregnancy. There were 2 stillbirths (0.87 per cent) in the series.

Tubal patency was found to be entirely absent in 338 tests (35 per cent). Thirty women in this group subsequently conceived, perhaps because of a therapeutic property of the heavy iodized oil. In 623 patients (65 per cent), one or both tubes were patent to some degree, and of these 37.4 per cent became pregnant. Ten pregnancies occurred over a year after hystero-graphy.

In 64 patients (6.3 per cent), there was intravasation of the medium into the uterine sinuses, circulation, and venous supply. In 1 case Lipiodol pneumonia developed. Salpingitis occurred in 6 women (0.6 per cent); of these 4 required surgery, and 2 became pregnant. There were no fatalities.

The author emphasizes the importance of repeated testing before bilateral occlusion is definitely accepted.

Three roentgenograms; 4 tables.

**Hysterosalpingography Using Salpiz. Preliminary Report.** W. J. J. Czyzewski. *Brit. J. Radiol.* 29: 679-681, December 1956. (Oldchurch Hospital, Romford, Essex, England)

The author reports his experience with a new opaque



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substance, Salpex, used for hysterosalpingography. Salpex is a combination of a solution of polyvinylpyrrolidone (P. V. P.) and of sodium acetizoate. The former provides the necessary viscosity and tissue adhesiveness; the latter possesses a high radiopacity, its iodine content being 65.8 per cent. Experimental studies with the medium and, in particular, investigations of the excretion of polyvinylpyrrolidone, while not conclusive, do not appear to contraindicate clinical application.

Sixty examinations were carried out in the investigation of infertility. Salpex was injected under fluoroscopic control and at least two films were taken at this stage of the examination, followed by delayed films at various intervals between ten minutes and four hours later. Adequate filling of the uterus and of the tubes generally was obtained without any difficulty, and the contrast was as good as that obtained with iodized oil.

According to the author, this compound possesses the same advantages as iodized oils and none of the disadvantages, and its viscosity is superior to that of aqueous media. In cases with patent tubes the uterus was almost empty in ten to fifteen minutes, and adequate spill was present in the peritoneal cavity with absorption from this area usually complete within ninety minutes after the injection. Salpex is practically non-toxic, but controversial views on possible retention of polyvinylpyrrolidone in the human organism are recorded and consequences resulting from this retention are discussed. There were practically no side-effects in the series reported and the patients were able to leave within a few minutes after the last film was taken.

Four roentgenograms; 1 table.

JULIAN O. SALIK, M.D.  
Baltimore, Md.

**Visualization of a Pericervical (Venous or Lymphatic?) Vascular Plexus in the Course of Hysterosalpingography.** A. D'Agostino. *Ann. radiol. diag.* 29: 482-496, 1956. (In Italian) (Pio Istituto di Santo Spirito ed Ospedale Riuniti di Roma, Rome, Italy)

During a hysterosalpingography, opaque medium was injected under relatively high pressure, in an attempt to visualize the tubes, but these were completely obliterated. Instead, there appeared linear strands of contrast material, extending from the left lateral aspect of the uterine cavity toward the lower end of the projection of the left sacroiliac joint space. On the basis of anatomical considerations, the opinion is expressed that these streaks of contrast material represented the lymphatic plexus of the uterine cervix. [Although this is not stated in the paper, the appearance resembled pyelo-lymphatic backflow, which is not an unusual finding when instillation pressure is raised during retrograde pyelography.—E.R.N.G.] The visualization of the pericervical lymph channels in the case reported caused no untoward effects, and all traces of contrast material had disappeared when a roentgenogram was exposed twenty-four hours after the procedure. The medium used was 40 per cent Lipiodol F (fluid), a product in which ethylic alcohol is substituted for the glycerin in the molecule.

The paper contains also a reproduction of another hysterosalpingogram showing both tubes and a bilateral pericervical vascular plexus. There is, however, no caption, nor is the case mentioned in the text.

Five roentgenograms; 2 drawings.

E. R. N. GRIGG, M.D.  
Cook County Hospital, Chicago

**The Clinical Use of Radiology in Placenta Praevia. A Review of 433 Cases of Ante-Partum Hemorrhage Examined Radiologically (1951-1954).** David W. Lindsay and John K. Davidson. *J. Obst. & Gynaec. Brit. Emp.* 63: 878-883, December 1956. (D. W. L., Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, Scotland)

Radiology is being used with increasing frequency in the diagnosis of placenta praevia. During the four-year period 1951 to 1954, 433 patients with ante-partum hemorrhage had x-ray studies at the Simpson Memorial Maternity Pavilion, Edinburgh. The technic employed in the x-ray department of that hospital for localizing the placental site relies entirely on straight radiography with the fetus acting as a contrast medium.

Views are taken with the patient in such a position that the fetus is above the suspected soft-tissue shadow. Under gravity the fetus sinks to the most dependent part, displacing any liquor amnii but not the placenta. Difficulties arise when there is a relative excess of liquor amnii masking the placenta, as in early pregnancy and in hydramnios. Extrinsic soft-tissue masses are confusing, and it is therefore important that the bladder and rectum be emptied prior to radiologic examination. Other soft-tissue masses, such as uterine fibroids or ovarian cysts, simulate the placenta, and their presence can only be suspected radiologically by their shape and position. In the absence of the complications mentioned, the information obtained from the radiologic examination is definite and reliable.

The lower uterine segment in the latter months of pregnancy is considered to lie at the pelvic brim posteriorly and about 1 inch above the brim anteriorly. For reporting placenta praevia, the following classification has been adopted. In *Type I* the mass of the placenta is above the brim, with the margin dipping slightly down into the pelvis, displacing the presenting part. Anteriorly there may be normal separation of the fetus from the symphysis, but when the main mass of the placenta is immediately above the brim it is termed a *Type I* placenta praevia. In *Type II* the mass of the placenta is at the brim with the margin unlikely to extend as far as the internal os. In *Type III* the mass of the placenta is slightly below the brim with the margin probably covering the internal os. In *Type IV* the mass of the placenta is in the pelvis. Radiological and clinical classifications may not always agree, since the latter is determined by the position of the margin of the placenta. The discrepancy, however, should not be greater than one type.

In 296 of the 433 cases studied, the radiologist reported "no placenta praevia," and in 299 of these, the condition was excluded clinically. The remaining 3 cases were classified obstetrically as placenta praevia. In 1 of these, a *Type II* posterior, an abnormal quantity of gas was demonstrated in the rectum, and this was accepted as the cause for separation of the fetus from the promontory. The other 2 were of *Type I*: 1 revealed a definite soft-tissue shadow immediately above the symphysis pubis in the lateral view and would now be reported as *Type I* anterior placenta praevia.

Eighty-three cases were reported radiologically as possibly *Type I*, *Type I*, or possibly *Type I* or *II*; 25 cases were considered clinically to be placenta praevia. In many cases in this group there was no clinical indication for exploration of the lower uterine segment, as labor began spontaneously without recurrence of bleeding and the radiologic diagnosis could not be verified.

A total of 54 cases were reported as Types II, III, and IV, and in 42 of these the radiologic diagnosis was confirmed. In the 12 cases in which placenta praevia did not occur, the radiologic examination was incomplete or the picture was complicated by the presence of malpresentation, uterine fibroids, hydramnios, or other complications.

The value of determining the placental site on all routine roentgenograms in obstetrics is emphasized.

Seven figures.

**An Evaluation of the Accuracy of Diagnosis in Placenta Praevia.** W. H. Allemang, K. E. Hodge, and J. L. Harkins. *Canad. M. A. J.* 75: 904-909, Dec. 1, 1956. (Toronto General Hospital, Toronto, Canada).

To obtain consistently good soft-tissue films for placental localization, the authors have established for routine use in the Toronto General Hospital a modification of Reid's method of gravitational roentgenography (*Brit. J. Radiol.* 22: 557, 643, 1949. *Abst. in Radiology* 55: 462, 1950). After describing this procedure in detail, they report that, when supplemented in some cases by arteriography, it had an accuracy, in 69 cases of bleeding in the last trimester of pregnancy, of 94.2 per cent. In 17 cases of placenta praevia, only 2 minor errors were made. The technic proved particularly useful in 12 cases of major degrees of placenta praevia. It gave correct results in 10 cases of placenta praevia investigated between the twenty-eighth and thirty-fourth week of gestation, while vaginal examination in 25 cases of placenta praevia in this stage of pregnancy showed 3 major and 2 minor errors in placental localization.

Vaginal examination, however, is useful in excluding lesions of the lower genital tract and in those cases of placenta praevia where expectant treatment is not indicated. Where prolonged hospitalization is required, roentgenography is advantageous and accurate. The authors conclude that, for best results, x-ray and vaginal examinations should be combined.

Six roentgenograms; 4 tables.

### THE GENITOURINARY SYSTEM

**The Significance of Renal Displacement.** William J. Engel. *J. Urol.* 76: 478-487, November 1956. (Cleveland Clinic Foundation, Cleveland, Ohio)

Renal displacement as demonstrated on plain roentgenograms or urograms may result from multiple causes and is not limited to cases of retroperitoneal tumor. The causes may be extrinsic or intrinsic. Extrinsic lesions produce an abnormal position of the entire kidney. Certain intrinsic lesions will produce only displacements of the renal pelvis, while others, as large cysts and neoplasms, will affect the entire organ.

In a review of a series of normal urograms it was found that the long axis of each kidney runs obliquely away from the mid-line at about 20°, generally paralleling the psoas margin. In no normal case was there displacement of the upper pole away from the mid-line, although there was some variation in the position of the lower pole. The right kidney is usually lower than the left.

Certain generalizations are made as follows: (1) There is no typical displacement which may be regarded as diagnostic of a particular lesion. (2) Displacement of the kidney usually denotes a retroperitoneal mass. (3) The direction of displacement limits the number of

probable causes and a careful history helps in further reducing the possibilities. (4) Extreme renal displacement may be present in the absence of a clearly palpable mass and more often indicates a benign tumor than a malignant one.

Particular attention is directed to abnormal position of the renal pelvis or its upper calyces in the duplex kidney with complete ureteral duplication associated with an ectopic orifice to the ureter of the upper pelvis. In this situation the upper pelvis is frequently infected and hydronephrotic, while function is so impaired that there is no excretion of contrast medium. The lower portion of the kidney, however, whose ureter empties normally into the bladder, retains normal function and is well visualized.

If the shadow of the entire renal mass were always clear, absence of pelvic filling in any portion would be easily recognized, but this is frequently not the case. Certain roentgen signs should be sought. In some cases there may be a slight outward deflection of the uppermost filled calyx. In others the lower pelvis will be displaced laterally, but always with a characteristic outward bending of the uppermost calyx. On the affected side the pelvis may appear smaller. There may be some deviation of the normal ureter in its course from the lower pelvis to the bladder.

Minimal or marked renal displacements may be associated with adrenal tumors, retroperitoneal hematomas, aortic aneurysm, perinephric abscess, pancreatic cysts, enlarged liver or spleen.

Fifteen roentgenograms; 3 photographs.

JOHN F. RIESSER, M.D.  
Springfield, Ohio

**Radiologic Diagnosis of Renal Tumours by Renal Angiography.** John H. Woodruff, Jr., and Richard E. Ottoman. *J. Canad. A. Radiologists* 7: 54-58, December 1956. (Torrance, Calif.)

The authors list the following indications for renal angiography: (1) negative urographic and pyelographic studies in the face of strong clinical evidence of renal neoplasm; (2) equivocal urographic and pyelographic findings suggesting renal neoplasm; (3) renal space-occupying lesions of uncertain origin; (4) need of evaluation of a renal tumor to determine its operability or the optimum surgical approach; (5) failure of other roentgen studies to distinguish between an extrarenal and an intrarenal tumor. Contraindications relate chiefly to sensitivity to contrast media and impaired renal function.

The cases considered in this paper were examined by translumbar aortography as described by Walter and Goodwin (*J. Urol.* 70: 526, 1953. *Abst. in Radiology* 63: 300, 1954). The series included 137 aortograms with no fatalities. The authors recognize, however, that the procedure involves a small but significant hazard and discourage its routine use.

While it is not possible for the radiologist to distinguish with absolute certainty between renal cysts and tumors, a high degree of accuracy is theoretically possible. The presence of tumor vessels is pathognomonic of a malignant tumor. Less than one-third of all renal tumors will fail to show such a vascular pattern.

Tumor vessels are characterized by a disordered abundance. The normal arborization and progressive diminution in caliber from the main trunks to the terminal small arteries are replaced by variable degrees of abnormality. Usually there is an increase in vascularization.

The vessels show irregular dilatations, with puddling of contrast material. They may terminate in blind blunted pouches. In most cases tumor vessels are readily identified. Tortuous vessels and areas of hemorrhage may, however, be a source of confusion.

About 9 cortical carcinomas in 10 will show tumor vessels. Failure to demonstrate them is due to necrosis, avascularity, cystic degeneration, or failure to make the exposure at the proper time. The authors know of no other renal neoplasms, with the single exception of liposarcoma, in which tumor vessels can be shown.

Seven roentgenograms; 1 table.

JOHN P. FOTOPoulos, M.D.  
Hartford, Conn.

**The Triple Voiding Technique in Children with Dilated Urinary Tracts.** John K. Lattimer, Archie L. Dean, Jr., and Clement A. Furey. *J. Urol.* 76: 656-660, November 1956. (J. K. L., 180 Fort Washington Ave., New York 32, N. Y.)

Triple voiding is a simple and effective means of reducing the amount of residual urine in children. The child voids once, then walks around the bathroom for two minutes, voids again, walks for two minutes more, and voids a third time. This procedure is repeated every two hours during the day and twice at night. The only limitation of the maneuver is that the child must be old enough to co-operate.

The triple-voiding technic has special application in cases of bladder neck obstruction before and after operation. It is also used in cases of neurogenic bladder and ureterovesical obstruction, promoting the emptying of large bladders and ureters and dilated renal pelvises.

Triple-voiding cystograms are useful for evaluating results of operations on the bladder neck. The bladder is filled with a dilute solution of neomycin and contrast medium. Immediate and thirty-minute delayed films are then taken. The patient is asked to triple-void, and films are taken after each voiding. If the patient is too young to co-operate, the bladder is emptied by opening the indwelling catheter and permitting the contents of the bladder to run out. Films are then obtained immediately and after ten minutes. The cystograms permit the detection of any trapping, e.g., above the ureterovesical junction. The results determine the choice of further operative procedures.

Eighteen roentgenograms.

JOHN F. RIESSER, M.D.  
Springfield, Ohio

**A Fatal Reaction Following Injection of Urographic Medium: A Case Report.** W. W. Payne, William H. Morse, and Samuel L. Raines. *J. Urol.* 76: 661-663, November 1956. (S. L. R., 188 S. Bellevue, Memphis 4, Tenn.)

In the course of a diagnostic study on a 65-year-old Negro an excretory urogram was desired. The patient was prepared with 45 c.c. of castor oil at 4 P.M. the day prior to examination and received nothing by mouth after midnight. There was no history of allergy or of previous urography.

After injection of a 1 c.c. test dose of Miokon intravenously, the patient complained of a choking sensation and Benadryl was given. A convulsion followed, during which 50 mg. of sodium pentobarbital was injected intravenously. Oxygen was administered through an endotracheal tube, but profound shock developed and death ensued.

In the opinion of the authors the patient suffered an anaphylactic reaction to the test injection; viz., bronchial spasm, convulsion, and shock. It is pointed out that the individual may not be sensitive to the drug *per se* but to the conjugate of drug antigen and body protein. The usual skin or conjunctival tests may well be negative. With present knowledge, these rare catastrophes cannot be prevented.

JOHN F. RIESSER, M.D.  
Springfield, Ohio

**Air Embolism Following Retroperitoneal Pneumography: A Nation-Wide Survey.** Charles L. Ransom, Ralph R. Landes, and Robert McLelland. *J. Urol.* 76: 664-670, November 1956. (776 Main St., Danville, Va.)

The major complication of retroperitoneal pneumography is gas embolism. A fatal reaction during presacral injection of air is reported. Cardiac arrest followed injection of 500 c.c. While resuscitative measures were being used, a supine film of the abdomen was made, demonstrating large quantities of air in the vena cava and hepatic veins.

Prompted by this fatal reaction, the authors addressed a questionnaire to the urologists listed in the *Directory of Medical Specialists*. Six hundred eighty-six of the 1,267 replying stated that they performed presacral pneumography. Three hundred twenty-one of these indicated the number of such examinations performed. These totaled 9,201. The gases employed were air, oxygen, carbon dioxide, and helium.

Fifty-eight deaths from gas embolism were revealed, 24 following presacral and 34 following flank injection. There were 64 severe nonfatal cases, 33 with the presacral and 31 with the flank procedure. There was thus a greater number of deaths and severe reactions with the less frequently employed flank route.

The solubility of nontoxic gases is the main factor in determining safety. Oxygen is no safer than air, and helium is more dangerous. The marked solubility of carbon dioxide permits its direct injection intravenously without untoward reaction. It has been used as a contrast agent in cardioerentgenography and hysterosalpingography. In the volume necessary, given at a reasonably slow rate of injection, carbon dioxide would appear an almost innocuous gas for use in retroperitoneal pneumography.

One roentgenogram; 5 tables.

JOHN F. RIESSER, M.D.  
Springfield, Ohio

## TECHNIC

**The Use of Hydrogen Peroxide to Eliminate Intestinal Gas.** L. Arrieta Sánchez. *Radiologia* 7: 17-18, December 1956. (In Spanish) (Hospital Santo Tomás, Panama City, Panama)

Many procedures have been suggested for the elimination of disturbing bowel gas, which often obscures the findings in pyelography and cholangiography. Antonio Govoni (Florence, Italy) employed enemas containing for each liter of water 10 c.c. of hydrogen peroxide (40 volumes). This method was also tried by James Brailsford and Eric Mucklow (London, England), with 25 minims of  $H_2O_2$  (20 volumes) for each pint of water (see Govoni, Brailsford, and Mucklow: *Am. J. Roentgenol.* 71: 235, 1954. *Abst. in Radiology* 63: 907, 1954).

The hydrogen peroxide is supposed to produce neuromuscular excitation of the colon, thus stimulating the evacuation of its contents, and at the same time increasing the intraluminal pressure, which is said to favor the transfer of gas from the colon into the blood.

The present author, who previously employed tannic acid (diluted in the enema water), decided to change to hydrogen peroxide, because tannin appeared to be irritating and the patients complained of severe colics.  $H_2O_2$  proved as effective as tannic acid, with no discomfort to the patient.

E. R. N. GRIGG, M.D.  
Cook County Hospital, Chicago.

**Improved Definition in X-Ray Diagnosis by High Voltage Projection Microradiography.** W. C. Nixon. Brit. J. Radiol. 29: 657-662, December 1956. (Cavendish Laboratory, Cambridge University, Cambridge, England)

Radiographic technic used for the study of thin biological and metallurgical specimens has led to the development of the projection microradiographic (PMR) tube. This consists of a hot tungsten filament and magnetic reducing lenses which produce a point source of electrons striking a thin target in the tube end. The focal spot is thus extremely small. Radiographs are made with specimens at a distance from the film, and considerable magnification has been possible without significant loss of definition or detail. However, the voltages applied have been low, and thick specimens have shown considerable unsharpness.

The author here presents preliminary experimental work with high-voltage PMR tubes, and illustrates his results with a number of radiographs. Some of the apparent advantages are as follows: The total x-ray tube load is less for small focal spot radiography. Exposure times are in the same region as for conventional radiography but definition is about ten times better. Medical fluoroscopy requires less tube load so that the observation time can be prolonged and image enlargement ( $\times 10$ ) becomes possible with patient still within arms reach of the radiologist.

The author suggests that, when more fully developed, the method will permit radiographic detection of smaller tumors, lesions, stones, etc.; will produce higher definition on body-section radiography; will result in more sharpness when image intensification technics are used; and will improve generally the quality of all films which may be made.

Ten roentgenograms; 2 drawings.

DON E. MATTHIENEN, M.D.  
Phoenix, Ariz.

**Automatic Exposure Timers in Practice.** F. E. Stieve. Röntgen-Blätter 9: 325-333, October 1956; 363-372, November 1956. (In German) (Institut und Poliklinik für physikalische Therapie und Röntgenologie der Universität München, Munich, Germany)

In 1929, Franke observed that every roentgenogram, whatever the part of the body it represented, contained a "dominant zone" which had to reach a certain density before that particular roentgenogram could be regarded as satisfactory. Furthermore, there was approximately the same degree of darkening of the "dominant zone" on all satisfactory roentgenograms, and it was concluded that the film must have been reached by the same dose (in r). Accordingly, Franke constructed an automatic exposure timer, based on an ionometer (ion-

tomat). Despite its shortcomings (extreme wavelength dependency and an excessive minimal possible exposure time) it was a workable device. The other solution, which used a photoelectric cell (phototimer), was developed by Hodges and Morgan, and had initially similar drawbacks. In the meantime, both methods have been considerably improved, and are available commercially in many combinations (with or without Bucky, on spot-film devices, and even with image intensifier).

The question is whether, with modern installations, used by an experienced technician who takes the time to measure and position the patient carefully, the degree of density can be duplicated on successive exposures. After reviewing the international literature and his own experience, the author concludes that only by using an automatic exposure timer may one compensate for the variations in the powerline ( $\pm 15$  volts), for changes in the output of the tube (the anode is less efficient before warming-up; conversely, after 10,000 exposures, its output decreases by up to 30 per cent, after 30,000 exposures by up to 40 per cent), for differences in the proportion of (highly radiolucent) fat and (more opaque) muscles in individuals with the same overall measured thickness, and especially for the modifications in exposure necessary during oblique projections (gallbladder, kidney, gastrointestinal spot-filming).

Any automatic exposure timer will give satisfactory results only if and when uniformity is maintained in (1) the backwalls of the cassettes, (2) the quality of the re-enforcing screens, (3) the film sensitivity (constant emulsion speed), and (4) darkroom processing by the time-temperature method. Positioning of the patient is also more critical with automatic timing. On the other hand, an overall improvement in film quality will be obtained, roentgenograms taken at different intervals will be of comparable density (even if the technical factors previously used are unknown), and the optimum dosage will have been employed, independent of the variations in the output of the installation.

Six roentgenograms; 9 graphs.

E. R. N. GRIGG, M.D.  
Cook County Hospital, Chicago

## MISCELLANEOUS

**Roentgen Demonstration of Gauze Compresses in the Abdomen.** Oscar F. Noguera. Acta radiol. interam. 6: 111-116, April-June 1956. (In Spanish) (Santa Fe 1643, Buenos Aires, Argentina)

The author bases his paper on a series of 37 cases, believing that radiologic examination plays an important part in the diagnosis of abdominal masses due to sponges. He correlates the clinical and radiologic findings with the pathologic evolution following the over-look of a sponge in the abdomen and divides this evolution into five periods.

The first period is marked by a slight increase of serous fluid and the quantity of plastic exudates. The discovery of cases in this first stage is usually the result of a recount of the compresses and recognition of the loss. The mass should be movable and painless, and should cause displacement of surrounding organs.

The second period is that of abscess formation, which occurs after a variable number of days. A general sepsis and diffuse peritonitis may develop but a localized



abscess is more common. It begins within the first few weeks; sometimes the contents are drained by the formation of fistulous tracts. Radiologically, there is a fixed, painful, irregular mass containing multiple small gas shadows similar to a honeycomb.

In the *third* period, the gauze has become impregnated with radiopaque substances and it now begins to lose its characteristic radiologic aspect.

The *fourth* period is characterized by the tendency to elimination of the gauze, through some fistulous tract, into the intestinal lumen, vagina, bladder, or even onto the exterior skin surface. When one finds in the intestinal lumen a foreign body which takes up the opaque substance and which maintains its increased shadow in spite of elimination of the rest of the opaque bowel content, one must think of a gauze sponge.

The *fifth* period, except in cases where the tumor becomes calcified, is characterized by encystment. In this stage the gauze has become resistant to disintegration.

Radiologically, there is a nonspecific mass, fixed and painless.

Seven roentgenograms. JAMES T. CASE, M.D.  
Santa Barbara, Calif.

**The Use of X-Ray Examination in Medicolegal Autopsies.** Keith Bowden. M. J. Australia 2: 923-925, Dec. 22, 1956. (Coroner's Department, Melbourne, Australia)

Of the various ways in which radiological examination may be employed in medicolegal autopsies, the most useful is the discovery of bullets. Here roentgenography may save much time and dissection. Without it bullets or their fragments may be overlooked, especially in decomposed bodies or in those partly destroyed in other ways. The examination may also be of value in establishing identity. Ten cases are reported to illustrate these points.

One roentgenogram.

## RADIOTHERAPY

**20 Million Volt X-Ray Therapy.** T. A. Watson. Acta radiol. interam. 6: 102-105, April-June 1956. (Saskatoon City Hospital, Saskatoon, Saskatchewan, Canada)

The author reports on the use of high-energy betatron x-rays in 134 advanced cases of cancer. Since the treatment was admittedly experimental, only patients with such far advanced disease that no conventional type of treatment would offer a reasonable chance of cure, and in whom a pathological diagnosis had been obtained, were selected. Of 21 patients with cervical cancer (all beyond Stages I and II), 4 received less than half the planned-treatment dose (6,000 r to the whole pelvis in three weeks or 7,000 r in five weeks). Eight of the remainder were well at the time of the report, eighteen months to five years after irradiation; the average time of survival after treatment of the other 9 was twenty months. No late complications such as fistula or persistent bowel or bladder reactions were observed. All patients showed a satisfactory immediate primary resolution of the tumor and were at one time or another after treatment considered clinically free from disease.

Thirty-one cases of advanced infiltrating carcinoma of the bladder were treated. Seven, who did not complete more than half the planned treatment (6,000 r in three weeks), died; 10 were well from one to five years after irradiation; and 1 was alive with residual tumor after twenty months. Autopsy showed complete resolution of the bladder tumor in some cases.

In 2 of 10 cases of brain tumor, therapy had to be discontinued. Of the remaining 8, 3 had been well, at the time of the report, for four to five years, and 1 was alive but suffering from recurrent astrocytoma. Four had died, of whom 2 had astrocytoma and 2 had glioblastoma multiforme.

All but 1 of 10 patients with inoperable cancer of the rectum died following betatron therapy. The survivor showed residual disease after twenty-one months.

Large-field irradiation was given in 29 cases of lung cancer. Four patients were alive seventeen to forty months later; the average time of survival for the others was eight months. In a large proportion of these, however, there was both symptomatic and roentgen im-

provement, indicating that treatment was useful from a palliative point of view.

While the author found that betatron x-rays have no obvious specific biological advantages over conventional roentgen therapy, they do have certain physical benefits: minimal constitutional effects due to low integral dose; flat isodose curves permitting simple layouts, if suitable compensating filters are used; lack of variation of depth dose with field size; low skin dose; negligible skin reactions even when high tumor doses are obtained; no hazards or late radiation changes in the skin or any subcutaneous fibrosis. He feels that if he had to choose between the various types of supervoltage equipment presently available, and if economic factors were of no importance, he would choose the betatron.

**Combination Therapy of Retinoblastoma with Triethylene Melamine and Radiotherapy.** George A. Hyman and Algernon B. Reese. J. A. M. A. 162: 1368-1373, Dec. 8, 1956. (G. A. H., 622 W. 168th St., New York 32, N. Y.)

This report is based upon a series of 50 children between the ages of two months and seven years who were treated for retinoblastoma with a combination of x-ray irradiation and triethylene melamine. Only cases in which the disease had not extended beyond the local area were treated. The radiation dose was 2,400 r (air) to each of two portals. The drug was administered by mouth, intramuscularly, or into the carotid artery with the dose being given according to weight.

In 12 of the 33 children who received triethylene melamine by mouth the tumor was arrested and vision preserved. In 7 of 8 in whom the drug was given intramuscularly the same satisfactory results were achieved, and in 2 of the 9 "almost hopeless cases" in which carotid injection was employed the tumors were arrested and vision preserved. The results obtained show a 42 per cent arrest of the tumor and preservation of vision when all cases are considered. This is considerably better than the 23 per cent retention of useful vision and tumor arrest previously obtained by one of the authors when radiation alone was used (Reese *et al.*: Am. J. Ophth. 32: 175, 1949) and makes a fairly strong case for the synergistic effect of radiation therapy and

triethylene melamine in the treatment of retinoblastoma.

Four photographs; 4 tables.

CHARLES E. DUISENBERG, M.D.  
Palo Alto, Calif.

**Clinical and Statistical Studies of Carcinoma of the Mouth and Pharynx Treated from 1928 to 1945. XIII. Results of Irradiation of Carcinoma of the Rhinopharynx in 32 Cases.** Guido Luzzatti. *Radiol. med.*, Milan 42: 1200-1231, December 1956. (In Italian) (Istituto di Radiologia dell'Università di Milano, Milan, Italy)

Between 1928 and 1945, 32 patients with carcinoma of the rhinopharynx were treated in the Tumor Clinic of the Department of Radiology of the University of Milan. Biopsy was obtained in 28 (84 per cent), but the histologic type was determined in only 27: 12 (44 per cent) squamous-cell, 12 (44 per cent) undifferentiated, and 3 (11 per cent) rhinopharyngioma [lymphoepithelioma?].

When first seen, 4 of the patients had recurrences after a radiologic "cure." 5 had received roentgen therapy over lymph node metastases in the presence of an unrecognized primary, 2 gave a history of surgical removal of rhinopharyngeal vegetations, assumed to be of benign, polypous nature, and 1 had a local recurrence after roentgen therapy and incomplete surgical removal of lymph node metastases.

Between 1928 and 1932 roentgen therapy was given through two or three 10 X 10 or 15 X 15-cm. ports (155 kvp, 30-40 cm. TSD, 0.5 mm. Cu plus 1.0 mm. Al filtration), for a dose of 600 r per port in ten to twelve days. Later, under the influence of Coutard's publications, fractionated and protracted doses were employed, the factors being 170-180 kvp, 40-50 cm. TSD, 1.0 mm. Cu plus 3.0 mm. Al filtration. With this technic, each of two or three 6 X 8 or 8 X 10-cm. ports received 2,000 to 3,000 r in twenty to thirty days. Radium therapy was administered by molds applied (externally) over the temporo-masseteric region and later by intracavitary procedures (10-20 mg. Ra, filtered with 1.0 mm. Pt, left in place for two to nine days).

Only 1 of the 32 patients was alive in 1955, eighteen years after treatment. This case was among the 6 classified as "curable, without lymph nodes," in which there were 4 other five-year survivals. Among the 8 in the group "curable, with lymph nodes," 1 died in first year, 6 in the second and third years, and the last after almost eight years. None of the 18 patients in the "hopeless" group survived three years, and 13 of them not even one year.

While the total results are, by the author's own admission, all but encouraging, there was a 66 per cent five-year survival rate in the category "curable without lymph nodes." Interesting also is the mention that a 40 per cent five-year survival was achieved when the tumor was localized on the anterior and superior wall of the rhinopharynx. The most unfavorable location was on the superior and lateral wall (after five years only 1 survivor among 9 patients observed). The figures are, however, too small for statistical significance.

Since 1945, methods have been improved, and the author outlines the present-day indications: (a) In cases of tumors limited to the nasopharynx, without evidence of invasion or of deposits in lymph nodes, roentgen therapy only, preferably convergent or pseudopendular, should be given up to 6,000 r in five to seven weeks, or 4,000 r in three weeks. If rotational methods

are not available, conventional deep therapy must be associated with endocavitary radium therapy. In any case, the primary as well as the first lymphatic echelon must be included in the irradiated volume. (b) When there is no invasion, but unilateral lymph nodes are involved, the primary should be treated as above; in addition, radical neck dissection ought to be considered. (c) In the presence of bilateral lymph node metastases, the prognosis is so poor that one is justified in withholding aggressive surgery. (d) When invasion beyond the rhinopharynx has occurred, the outcome is invariably fatal, but even then surprising remissions can at times be achieved with judicious application of roentgen and endocavitary radium therapy.

One graph; 10 tables. IRVIN F. HUMMON, M.D.  
Cook County Hospital, Chicago

**Tangential Irradiation in the Postoperative Treatment of Mammary Cancer.** Carlos E. Gárciga. *Acta radiol. interam.* 6: 78-84, April-June 1956. (In Spanish) (Calle 23, No. 669, Vedado, Havana, Cuba)

The author attributes the idea of tangential irradiation to Dr. Margaret Tod of the Holt Radium Institute of Manchester, England, and bases his technic on her practice. He reports the results obtained during four years employment of tangential irradiation by the "quadrate method." Treatment is given to three tangential fields: to two with a 20 X 20-cm. applicator and to the other with a 30 X 10-cm. applicator. In this way the entire pectomammmary zone and the lymphatic drainage of all the skin up to the vertex of the axilla are uniformly irradiated, without inclusion of the supraclavicular region. Total dosage for the three fields is 4,000 to 4,250 r in five weeks. In some cases this was increased to 5,000 or 5,500 r or, with inoperable tumors, to as much as 6,000 r in five weeks.

Of the 100 cases studied, 93 have been followed, the survival rates being 6.45 per cent for more than three years, 21.4 per cent for more than two years, 23.6 per cent for more than one year, and 8.6 per cent up to one year.

The author does not believe that this technic "really favors the ulterior evolution of the cases, nor does it reflect upon the survival time if compared with the results obtained with the classical irradiation technique, but he thinks its use advisable in recurrences or skin metastases."

Five figures; 5 tables. JAMES T. CASE, M.D.  
Santa Barbara, Calif.

**Breast Cancer: The Influence of Treatment That Fails to Cure.** Vincent P. Collins. *Cancer* 9: 1177-1181, November-December 1956. (Department of Radiology, Baylor University College of Medicine, Houston, Texas)

The problem of dealing with breast cancer is not solely, or even principally, our lack of knowledge of the tumor but rather the difficulty of analyzing and interpreting the vast amount of information dealing with the apparently innumerable variations in its behavior. Convictions are more easily formed than conclusions, and it is easier to recount an exception than to establish a general rule that will account for such behavior.

During the years 1915 through 1950, 957 patients with a diagnosis of breast cancer were referred to the radiotherapy department of Presbyterian Hospital, New York City. Of this group, 648 were deemed operable and were treated by radical mastectomy at some

time in the course of their disease. The remaining 309 patients were classified as inoperable because of age, competing disease, or refusal of surgery. Five hundred and seven patients treated by radical mastectomy were not cured. In 134 the first recurrence was at the operative site, in 109 on the chest wall, and in 25 in the axilla. Whether or not there were other distant metastases, primary treatment had thus failed to eradicate the disease in the treated area in 25 per cent. In 373 patients the first metastasis developed at a distant site. In this group it is likely that the distant metastases had occurred prior to treatment and the outcome of the disease could not be influenced by local treatment.

From his analysis of this series, the author concludes:

1. The primary treatment of breast cancer, whether surgical or radiological, exerts its effect in the area to which it is applied.
2. Local control or eradication of cancer in the primary-treatment area may not effect cure or influence survival, but failure to achieve local control does mean failure to cure.
3. When the first recurrence is in a distant site or when the patient dies of cancer with no recurrence in the treated area, metastases can be assumed to have occurred prior to treatment. These uncured patients offer the most direct evidence of efficacy of treatment.
4. In the present series, the only way in which the course of uncured breast cancer could have been altered by the primary treatment would be to have increased the percentage controlled in the operative site.
5. The comparative value of different treatment techniques and different treatment policies is obscured by analyses in terms of cure rates or survival rates.
6. Cure rates and survival rates indicate only that, throughout the world, approximately 40 per cent of breast cancers either grow locally and can be completely removed or grow so slowly that more than five years are required for recurrence to become manifest.

Six tables.

**Obstruction of the Superior Vena Cava in Carcinoma of Bronchus.** Leon Szur and L. L. Bromley. *Brit. M. J.* 2: 1273-1276, Dec. 1, 1956. (Medical Research Council Radiotherapeutic Unit and the Department of Surgery, Hammersmith Hospital, London, W. 12, England)

In an appraisal of carcinoma of the bronchus at the Hammersmith Hospital (London), the authors found that 167 (14.6 per cent) of 732 cases seen over a four-year period (1949-53) were complicated by superior vena caval obstruction. In the past the most frequent cause of such obstruction was considered to be aortic aneurysm with erosion of the right atrium or superior vena cava; less frequently infectious mediastinitis, carcinoma of the thyroid, metastatic carcinoma, malignant lymphoma, and "idiopathic" thrombosis were held responsible.

Symptomatically the chief complaint in this series of cases was dyspnea which, if present before the onset of obstruction, was markedly intensified by closure of the vein. A sense of fullness in the head, swelling of the neck, puffiness of the face, headache, drowsiness, and vertigo were common, the last 3 symptoms probably resulting from increased cerebral venous pressure. The classical physical signs occurred in all patients, although in varying degrees of severity. These included venous engorgement of the neck; congestion of the face with suffusion of the conjunctivae; frank edema

of the face, neck and often of the arms; and evidence of a collateral circulation. The signs and symptoms were intensified in the horizontal position, which could not long be tolerated by some patients.

The diagnosis was made chiefly on clinical grounds, although at times angiography, infra-red photography, and, in selected cases, bronchoscopy were employed. Due to the hazards involved and the likelihood of rigidity of the tracheobronchial tree, bronchoscopy must be undertaken with a great deal of care. Ninety of the patients were males. The age range was from twenty-five to eighty years but over 70 per cent of the cases occurred between forty-five and sixty-four years. In two-thirds of the cases the right main bronchus or right upper lobe was the site of the primary lesion.

Histologic proof was obtained in only two-thirds of the 107 cases but the clinical findings and course in the remainder were so typical as to make the possibility of any other diagnosis remote. The histologic findings were somewhat surprising: of the 69 proved cases 30 were anaplastic growths and 27 oat-cell carcinoma. There were only 12 squamous-cell carcinomas, or 17 per cent, as compared to an incidence of about 60 per cent in most general series of bronchial cancer.

Superior vena caval obstruction is particularly distressing in this group of patients. Radiotherapy resulted in considerable relief in a third of the patients and some even returned to work; fair relief was obtained in another third, and there were no effect in the remainder. Treatment should not be withheld and should be prolonged beyond immediate symptomatic relief in an effort to prevent a recurrence of the obstruction; 3,000 to 4,000 r in three to four weeks should be the goal. With voltages varying from 190 to 250 kv, h.v.l. 2 mm. Cu, this program was attempted. Only 5 patients, in exceptionally good condition, received radical treatment, based upon multiple small fields and careful beam direction; in others portals of varying size, from  $10 \times 20$  to  $7.5 \times 15$  cm., were approximated over and behind the tumor. Among the 68 patients who showed an adequate response, with relief of symptoms, only 13 had a recurrence of the obstruction.

The cause of caval obstruction was determined in 23 patients who came to necropsy. Direct infiltration of the vein by the primary growth was responsible in 4, extrinsic pressure by the primary tumor or involved nodes in 13, and thrombosis in 8. In 6 patients the superior mediastinum appeared normal and all of these had been considerably improved by therapy. Death from superior vena caval obstruction is most distressing and therapy should not be withheld because of inability to cure.

Two roentgenograms; 2 photographs; 1 graph; 4 tables.

SAUL SCHEFF, M.D.  
Boston, Mass.

**Carcinoma of the Esophagus. A Review of 381 Cases Admitted to Toronto General Hospital 1937-1953 Inclusive.** Robert A. Mustard and Olive Ibberson. *Ann. Surg.* 144: 927-940, December 1956. (R. A. M., 280 Bloor St. W., Toronto 5, Canada)

In a review of 381 cases the authors found that the majority of esophageal cancers are incurable by any means of treatment yet discovered. The main objective of therapy, therefore, should be to restore the ability to swallow and prolong survival of as many patients as possible, at the same time offering a chance of cure to those few who have localized lesions. Surgical excision

holds the greatest hope of cure for those with favorable lesions, with radiation therapy probably best able to provide palliation at minimal risk.

Three types of case suitable for primary surgical excision are classified, excluding limitations imposed because of age or poor general condition: (1) carcinomas of the hypopharynx or cervical esophagus, with the disease so limited that a transection is feasible; (2) tumors of the mid and lower thoracic esophagus which on radiological and endoscopic examination appear small and localized, without extension; (3) all carcinomas of the abdominal esophagus except those clearly "non-resectable."

Most patients with esophageal tumors considered unfavorable for excision should be offered the benefit which may be obtained from irradiation. One five-year survival is reported among 125 cases in which treatment of the primary tumor was by high-voltage radiation only. Since 1953, however, experience indicates that results of treatment by the cobalt "bomb" seem more favorable. Most cases managed in this way receive at least temporary palliation, while in a few the primary tumor may be obliterated.

The authors are skeptical of the chances of increasing the five-year survival rate by more radical excision and also feel that gastrotomy should be used as a last resort when other measures have failed or are contraindicated.

Two figures; 11 tables. FRANK T. MORAN, M.D.  
Auburn, N. Y.

**The Role of Irradiation in the Treatment of Carcinoma of the Corpus Uteri.** Ethlyn Trapp, Margaret Hardie, and Olive Sadler. *Canad. M.A.J.* 75: 898-904, Dec. 1, 1956. (925 W. Georgia St., Vancouver 1, B. C., Canada)

The authors summarize the results of irradiation in the treatment of carcinoma of the corpus uteri at the British Columbia Cancer Institute. One hundred forty-nine patients were treated between 1938 and 1949. Of these, 111 received their primary treatment at the Institute, while 38 were referred after earlier treatment elsewhere. In the group of 111, therapy, where possible, was by intracavitary radium followed by roentgen irradiation or surgery. Of 98 women thus treated, 52 (53.1 per cent) survived five to fifteen years, and 9 died of other causes, cancer-free. There were no survivals among the 11 given incomplete palliative radiation or the 2 who received no treatment. Of 19 patients referred for postoperative irradiation, 12 survived for five to fifteen years; of 12 treated for vaginal recurrence, 4 were living at the time of this report; 7 patients referred for treatment of recurrence outside the uterus all died.

Fifty-nine patients were treated between 1938 and 1954 by a "planned technic," such as advocated by Arneson and his associates (*Am. J. Obst. & Gynec.* 55: 64, 1948. *Abst. in Radiology* 52: 150, 1949). This consists in multi-source intracavity radium therapy followed by hysterectomy and bilateral salpingo-oophorectomy. All the cases in this series were in Stage I, Group 1, of the League of Nations classification of corpus cancer, *i.e.*, the growth was confined to the uterus and operation was considered advisable. Forty-eight patients were alive and well at the time of the report; of these, 12 were found at hysterectomy to have residual disease in the uterus. Two patients were alive with disease.

The authors believe that irradiation has a useful place in all stages of cancer of the uterine corpus: in Stage 0, for poor surgical risks; in Stage I (a) as the treatment of choice, (b) preoperatively in the "planned technic," (c) postoperatively in more advanced cases, (d) for poor surgical risks and anaplastic disease, and (e) prophylactically to prevent vaginal metastasis; in Stage II with hope of cure or for palliation.

Five figures; 3 tables.

**A Metastasising Adamantinoma of the Tibia.** A. D. Morgan and D. H. Mackenzie. *J. Bone & Joint Surg.* 38-B: 892-898, November 1956. (Westminster Hospital, London, England)

A man of forty-two years underwent a supracondylar amputation for a painful tumor in the upper third of the left leg, diagnosed by the pathologist as a spindle-cell sarcoma with myxomatous change and cavity formation. Twenty-two years later a painful swelling appeared over the ninth and twelfth ribs posteriorly. Biopsy revealed an anaplastic malignant tumor and radiographs demonstrated destruction of part of the eleventh rib with a pathological fracture. Comparison of the biopsy specimen with the tibial tumor removed earlier showed a similar microscopic picture. A diagnosis of adamantinoma was made.

Telecobalt therapy was given with a 30-curie source at 20 cm. source-skin distance. A total dose of 6,032 r (maximum) and 4,524 r (minimum) was administered in forty-three days through two fields, each 6 X 8 cm. Eight months later the patient was in excellent condition and the tumor had diminished to a fifth of its former size. There was some healing of the associated rib lesions.

This is said to be the first instance of tibial adamantinoma with metastasis beyond the inguinal lymph nodes proved microscopically.

The authors review the literature of adamantinoma of bone and accept 24 of the cases previously recorded. In 22 of these the tibia was the site of involvement. Fifteen of the patients were males; the age ranged from twelve to fifty-seven years.

The tumor is typically slow-growing and of low malignancy. Apparent cure has been effected in a third of the total cases reported by amputation or resection of the diseased bone. In a similar number of cases metastasis to the lungs or skeleton has occurred in spite of treatment.

One roentgenogram; 4 photomicrographs.

BYRON G. BROGDON, M.D.  
Parks Air Force Base, Calif.

**Diagnosis and Treatment of Eosinophilic Granuloma of Skull.** Robert S. Knighton and J. DeWitt Fox. *J.A.M.A.* 162: 1294-1297, Dec. 1, 1956. (J.D.F., The Henry Ford Hospital, Detroit 2, Mich.)

The authors report 5 cases of eosinophilic granuloma of the skull. Following biopsy, uniformly good results were achieved by x-ray therapy, with total doses of 600 to 2,000 r (air).

The authors point out that eosinophilic granuloma in the skull is frequently solitary and benign and that the prognosis is good. They stress the fact that diagnosis should be made by surgical biopsy. Excellent roentgenograms are included.

Five roentgenograms; 3 photomicrographs.

CHARLES E. DUSENBERG, M.D.  
Palo Alto, Calif.



**The Direct Measurement of Tissue Dosage in Deep Roentgen Therapy.** Georg Fuchs and Josef Hofbauer. *Röntgen-Blätter* 9: 358-363, November 1956. (In German) (Zentralröntgeninstitut des Kaiser-Franz-Joseph-Spitals der Stadt, Vienna, Austria)

In recent years, an increasing number of institutions have adopted the use of dosimeters of catheter type, introduced into body cavities for direct measurement of actual tissue doses during radiation therapy. The authors report their experiences with a minute "Strauss" chamber (connected to the "Mekapion"), which requires 2.5 r for complete discharge. Sterilizable containers are furnished by the manufacturer to facilitate insertion in various locations, for instance an 80-cm. catheter for the tracheobronchial tree.

With 170 kv and 0.5 mm. Cu filtration, 65 to 85 per cent of the surface dose was found to reach the larynx. The situation was less favorable in the epipharynx, where only 29 to 50 per cent was received by a tumor irradiated through 6 X 8-cm. lateral ports, at 170 kv, 0.5 mm. Cu, and 40 cm. T.S.D. Irradiation of the tonsil through a 6 X 8-cm. port, at 150 kv, 5.0 mm. Al, and 30 cm. TSD, gave 45 per cent depth dose; improving the quality to 170 kv, 0.5 mm. Cu, and 40 cm. TSD, increased the depth dose to 60 per cent, while the addition of an opposite port (on the healthy side) furnished 42 per cent depth dose, which was considered adequate for attainment of a satisfactory total dose.

In treating bronchogenic carcinoma, when the central ray penetrated only lung tissue, the tumor dose was 30 to 40 per cent higher than calculated from the tables; conversely, when the spine was interposed, the measured dose was 30 to 70 per cent lower. In the pelvis, perpendicular ports raised the dose to the cervix to the expected level, but oblique ports were much less reliable, especially in heavier patients; the findings seemed to indicate that under such circumstances more penetrating sources are desirable.

Two roentgenograms; 1 photograph.

E. R. N. GRIGG, M.D.  
Cook County Hospital, Chicago

**A Consideration of the Equivalent Circle Method of Calculating Depth Doses for Rectangular X-Ray Fields.** H. F. Batho, O. Theimer, and R. Theimer. *J. Canad. A. Radiologists* 7: 51-53, December 1956. (Vancouver, B. C., Canada)

Central axis depth dose data for circular fields have been obtained by numerous investigators for a variety of irradiation conditions. New surface back-scatter measurements for circular fields have also been published recently (*Brit. J. Radiol. Suppl.* 5). In theory it is possible from these data to calculate the dose at any point in a tissue-equivalent medium irradiated by x-rays, whatever the shape of the field.

For calculation of the depth dosage for square and rectangular fields the "equivalent circle method" proposed by Jones (*Brit. J. Radiol.* 22: 342, 1949. *Abst. in Radiology* 54: 798, 1950) and by Day (*Brit. J. Radiol.* 23: 368, 1950) is simplest in application. This method assumes that for every square or rectangular field there exists a circular field for which the central axis depth doses are identical. Knowing the radius (or area) of the equivalent circle, the central axis depth doses for a rectangular field may be read directly from curves for circular fields. Since the depth dose at any point inside or outside a rectangular field can be determined as the sum of difference of central axis depth dose or rec-

tangular fields, the equivalent circle method furnishes a complete solution for rectangular fields.

In this paper a more general approach has been made to the problem of equivalent diameters. In the transition from circular to elongated rectangular fields the purely geometrical aspect is dominant, and the conditions of irradiation, i.e., focus-skin distance, half-value layer and depth, appear only in second and third order terms. Further, compromise values of the constants in the second and third order terms have been adopted which appear to be sufficiently accurate for practical purposes over a wide range of irradiation conditions. It is thus possible to set up a single equation which yields the radius of the circular field which is equivalent with respect to the central axis depth doses to any given rectangular field. This equation is developed in considerable detail mathematically and the interested reader is referred to the original article.

The authors state that it is safe to assume that the values calculated from their equation can be used to determine equivalent radii for still harder radiation than that obtained from cobalt 60. They have not investigated the applicability of this equation to radiations for which the half-value layer is less than 0.5 mm. Cu, and no assumptions can be made about the extension to softer radiations. Even though the equivalent radii determined from their equation may prove unsatisfactory for softer radiations, no doubt satisfactory values of equivalent radii can be found. The method loses much of its convenience if different equivalent radii must be used for different irradiation conditions.

JOHN P. FOTOPoulos, M.D.  
Hartford, Conn.

**A Transit Dose Technique for the Determination of Doses in Inhomogeneous Bodies.** J. E. O'Connor. *Brit. J. Radiol.* 29: 663-667, December 1956. (St. Luke's Hospital, Dublin, Ireland)

Because there is a lack of homogeneity in the tissue densities of any cross-section of the human body, rotational therapy depth dose determinations are subject to wide error. This margin of error can be reduced somewhat by use of the method presented in this paper.

First, an ionization chamber is placed at the site of exit of the x-ray beam, making possible the measurement of that proportion of the primary radiation which traverses the patient's body. Next, similar determinations are made at 10° intervals around the entire periphery of the part under treatment. Third, the thicknesses of water-equivalent material which would transmit the same amounts of radiation are calculated for each measurement and are plotted on a graph to show the "effective shape" of the part.

Several applications of the method in the thorax, skull, and pelvis are described, and the usefulness and limitations of the technic discussed. It appears that direct ionization chamber measurements, when possible (as in the esophagus), do not always agree with the dose calculations. This apparently is due to variations in the scatter contribution from various anatomical parts, and to movements of patient and chamber during treatment. Therefore, neither the direct measurements nor calculations alone are entirely reliable. The most complete and accurate information can be obtained by combination of the two.

Seven figures; 1 table.

DON E. MATTHIASEN, M.D.  
Phoenix, Ariz.

## RADIOISOTOPES

**The Use of Radioactive Isotopes in Medical Diagnosis and Therapy.** K. Schärer. Schweiz. med. Wchnschr. 86: 1377-1384, Dec. 8, 1956. (In German) (Radiotherapeutische Klinik der Universität Zürich, Zurich, Switzerland)

The author reviews the use of isotopes in medicine without going into detail. He considers the diagnostic application of such preparations as iodine 131 for thyroid function and sodium 24, iodine 131 and phosphorus 32 for blood volume studies. The use of isotopes in tumor diagnosis is discussed, and brief mention is made of radioactive materials for roentgenography.

Therapeutic applications are illustrated by a case of cancer of the thyroid and, in a nineteen-year-old girl, a case of polycythemia. Mention is also made of the use of gold 198 for pleural effusion and ascites, of the instillation of radioactive isotopes in liquid form through a catheter for bladder tumors, and injection into the tumor itself of such isotopes as chromic phosphate 32, zinc 63, and gold 198.

The use of isotopes as a replacement for high-voltage x-ray machines is mentioned. Scandium, cobalt, silver, cesium, cerium, europium, terbium, thallium, tantalum, and iridium have been employed for distant and contact therapy, in the form of pellets and plates, and incorporated in plastic materials, as well as in form of needles.

Five roentgenograms; 6 drawings; 3 tables.

JULIUS HEYDEMANN, M.D.  
Chicago, Ill.

**The Radioisotope Renogram. An External Test for Individual Kidney Function and Upper Urinary Tract Patency.** George V. Taplin, Orsell M. Meredith, Jr., Harold Kade, and Chester C. Winter, with the technical assistance of Patricia Peel and C. William Beckner. J. Lab. & Clin. Med. 48: 886-901, December 1956. (Division of Pharmacology & Toxicology, Atomic Energy Project, University of California, Los Angeles, Calif.)

The radioactive Diodrast renogram test described in this report is an application of external gamma-ray scintillation counting technics to estimate the vascularity, tubular cell function, and patency of the upper urinary passages in each kidney area separately. The principles, methods, and equipment are basically the same as those used in the radioactive rose-bengal liver-uptake excretion test.

Experiments in rabbits revealed that tracer doses of either Diodrast or Urokon, labeled with  $I^{131}$ , can be employed as test substances. Tracings of renal uptake and excretion in certain specific renal abnormalities have characteristic patterns which demonstrate the extent and nature of the existing functional impairment. Animal studies also showed that blood clearance rates of  $I^{131}$ -labeled Diodrast may be detected externally, thus furnishing a rapid estimate of bilateral renal function. The combined procedure of determining uptake and excretion of Diodrast in each kidney plus simultaneous external measurement of blood clearance provides a new tool for further investigations in renal physiology on a dynamic basis.

Following successful preliminary trials in rabbits, the procedure was adapted to clinical use. It is safe and rapid (fifteen to thirty minutes) and may be performed in the office, clinic, or hospital with little or no discomfort to the patient.

The test provides qualitatively reproducible data which otherwise must be determined by intravenous pyelography and a battery of kidney function tests or, in many instances, by cystoscopy, bilateral ureteral catheterization, and retrograde pyelography. In addition to yielding information of diagnostic value, the test may be repeated at intervals to follow the patient's clinical progress pre- and postoperatively and as influenced by therapeutic measures.

Five figures.

**Isotope Radiographs for Localization of Renal Calculi During Surgery: A New Truly Portable Radiographic Unit Using a Radioisotope (Thulium 170) as an Energy Source.** Donald E. Burke. J. Urol. 76: 508-519, November 1956. (VA Hospital, Los Angeles, Calif.)

A portable radiographic unit utilizing a capsule of thulium 170 as an energy source, known as Thul-X, is described. The unit weighs 7 pounds and is  $9 \times 7 \times 6$  cm. in gross dimensions. It is made of lead surrounded by a chrome-plated, aluminum shell in such a way that the isotope is always surrounded by at least 1 inch of lead except at the aperture port through which the gamma rays are emitted when the unit is in use. It is operated by pushing a plunger which moves a cable against a spring pushing the capsule source opposite the cone aperture in the lead shielding.

Thulium 170 has a half-life of 129 days. The radiation consists chiefly of gamma rays, which have an energy of about 84 kv. There are also two groups of beta rays (maximum energies 884 and 968 kv), which are filtered in the present application.

Test radiographs were obtained of a milled aluminum step-wedge, after which *in vitro* experiments were conducted on surgically removed calculi placed in kidneys removed at autopsy. Further studies were done in cadavers under conditions approximating surgery.

In the operating room the Thul-X is placed in a long, sterile plastic bag and held by hand so that the source-film distance is about 7 inches. The device is aimed at the mobilized kidney, behind which, and in direct contact, is a special cassette. Exposure times vary with the age of the isotope, being about one second with a fresh source, two seconds at four months (one half-life) and four seconds at eight months. The plunger is operated by an assistant. The kidney is pierced by needles to aid in the localization of calculi.

Several representative radiographs are presented demonstrating a stone before removal, the kidney after removal of the stone, and a kidney containing a large staghorn calculus. Apparently there is no blurring as a result of holding the unit by hand. The radiation dose rate at the surface of the unit averages 75 mr/hour, which is well within permissible dosage levels for trained personnel.

The advantages of this isotope unit are: its small size and complete mobility; absence of electrical connections and explosion hazard; possibility of maintaining sterile conditions; low initial cost; ready availability to more than one operating room. The principal disadvantage is need for periodic replacement of the isotope source.

Thirteen roentgenograms; 5 photographs; 1 diagram.

JOHN F. RIESER, M.D.  
Springfield, Ohio

**Distribution and Concentration of Radioactive Au 198 in Inoperable Prostatic Cancer: Report of Necropsy Study.** Louis M. Orr, Miles W. Thomley, and James L. Campbell. *J. Urol.* **76**: 769-775, December 1956. (1300 Kuhl Ave., Orlando, Fla.)

In determining dosage requirements in the treatment of prostatic carcinoma with radioactive gold, not only must the gamma and beta radiation dosage be considered but also the distribution of the particles throughout the gland. The beta particles of radioactive gold have an average range of about 1 mm. With uneven distribution of the gold in the gland some of the tissue will thus be intensely irradiated, while some will receive no beta radiation at all. The gamma radiation also drops off fairly rapidly from the point source, due to the inverse-square law. However, since there are multiple point sources, there is cross-firing, so that all of the tissue is irradiated, though there may be marked differences at different points.

The beta radiation from radioactive gold is unrelated to the volume of tissue injected. On the other hand, there is a definite relationship between tissue volume and gamma ray dosage. In a sphere of 1 cm. diameter, for example, the gamma ray dose would be about 4 per cent of the total, while in a sphere of 5 cm. diameter the proportion would be 18 per cent. One millicurie of Au<sup>198</sup> per gram of prostate gives 6,600 gamma roentgens in a gland weighing 50 gm. and 8,800 gamma roentgens in a gland of 100 gm.

For some few hours following injection of the gold there is leaking into the adjacent lymphatics and nodes, but this loss is of little importance in calculating the total dose to the gland. The liver picks up intravasated gold and within a few hours will have maximum radioactivity that remains practically unchanged until radioactive decay occurs.

The authors have treated fewer than 100 patients for carcinoma of the prostate by radioactive gold. One patient came to necropsy three weeks after treatment with a total of 95 mc of the isotope. The prostate was found to contain 9 mc, the seminal vesicles 0.5, the liver 50, spleen 8, and the bone marrow 4.5 mc. The activity was far from homogeneously distributed within the prostate, where wide ranges were observed. In the sections of tissue where radioactivity was high there was no more than one-third of the desired 1 millicurie per gram of tissue. The cellular response at the site of greatest radioactivity was little different than that in sections where the dosage was minimal, there being viable tumor cells in both areas. The results indicate that the greater portion of the gold had gone to the liver, spleen, and bone marrow, and that the concentration used, 5 mc per cubic centimeter of solution, is inadequate to cause a local cancerocidal concentration of 1 mc per gram of tissue.

Despite the hazards of administration, leakage, inadequate dosage, and intravasation, the fact is that remarkable palliation often occurs and the authors are encouraged to continue their efforts in this direction. Complications involving the rectum may be avoided by packing it off through a perineal incision; lymphatic spread of the isotope may be promoted by the addition of hyaluronidase to attack migrant tumor cells in the lymphatics and their nodes; and solutions may be made more viscous to keep them in the prostate in greater concentration.

Three figures; 3 tables.

SAUL SCHEFF, M.D.  
Boston, Mass.

**Intracavitary Administration of Radioactive Colloidal Gold (Au<sup>198</sup>) for the Treatment of Malignant Effusions. A Report of Thirty-One Cases and an Appraisal of Results.** Melvin P. Osborne and Bradley E. Copeland. *New England J. Med.* **255**: 1122-1128, Dec. 13, 1956. (New England Deaconess Hospital, Boston, Mass.)

The authors discuss the results of the administration of radioactive gold (Au<sup>198</sup>) for the treatment of malignant pleural and peritoneal effusions in 31 patients seen at the New England Deaconess Hospital since 1951. The series was one of consecutive patients, all of whom were followed for a significant period of time.

Treatment was given in 17 cases of malignant peritoneal effusions. The usual cause of the effusion was metastasis from an ovarian tumor or from breast cancer. Between 87 and 107 mc of radioactive gold was used, depending upon the case. The authors recommend that the gold be instilled into the abdominal cavity through catheters which have been left in place following abdominal operation. Of the 17 patients treated for malignant peritoneal effusions 5 died too soon for the results to be appraised. In the remaining 12 cases there was effective control of ascites in 2, minimal control in 3, and no benefit in 7.

Fourteen patients with malignant pleural effusions were treated: 11 females and 3 males. In the females the metastatic lesions originated in the breast (8 cases) and the ovaries (3 cases). In the 3 male patients the condition was secondary to Hodgkin's disease of the lung, pulmonary carcinoma, and carcinomatosis of the peritoneum and pleural cavity from an undetermined site of origin. Of the 14 patients, 10 were followed long enough for adequate evaluation. Eight showed good results, with effective control of the effusion. The dose of radioactive gold used in these cases ranged from 69 to 106 mc.

The authors conclude that radioactive colloidal gold (Au<sup>198</sup>) offers a safe, predictable, and useful agent for the treatment of malignant pleural effusions. Results of treatment for malignant peritoneal effusions are less favorable.

Two figures; 2 tables. J. P. CHAMPION, M.D.  
Grand Rapids, Mich.

**Comparative Studies on the Effects on Bone Marrow of Radiogold and Radioyttrium.** R. Stodtmeister, K. E. Scheer, St. Sandkühler, and M. Th. Flidner. *Schweiz. med. Wchnschr.* **86**: 1450-1451, Dec. 29, 1956. (In German) (Czerny-Krankenhaus der Universität Heidelberg, Heidelberg, Germany)

Although radiogold (Au<sup>198</sup>) has a short half-life, favorable for therapeutic application (2.7 days), it nevertheless has undesirable side effects on the hemopoietic system following interstitial or intravenous application.

Previous observations of the authors with injection of 2 mc of Au<sup>198</sup> into rats corresponding to the lower limits of the LD 50 revealed a damage to the bone marrow similar to that obtained with corresponding amounts of x-rays or fast electrons (*Schweiz. med. Wchnschr.* **85**: 942, 1955). This effect on the white cells is markedly lessened with doses within therapeutic limits, but is still present.

Y<sup>90</sup> has a half-life (2.6 days) similar to that of Au<sup>198</sup>; it is more readily available and its transportation is more economical. It originates from disintegration of strontium 90 (half-life ninety years) and can be separated electrolytically with sufficient purity. Y<sup>90</sup> is deposited

predominantly in the compact layer of bone, whereas  $\text{Au}^{198}$  is distributed predominantly in the marrow.

Comparison of white blood cell curves after intravenous injection of 0.9 mc of  $\text{Au}^{198}$  and 0.3 mc of  $\text{Y}^{90}$  into adult rats shows a lesser but still obvious hemodilutive effect of  $\text{Y}^{90}$ . This probably is the result of irradiation of the peripheral bone marrow from  $\text{Y}^{90}$  deposited in the adjoining compact layer of bone in addition to the radiation from the small percentage of  $\text{Y}^{90}$  distributed throughout the marrow.

Widening, edema, and hemorrhage of the sinus system of the bone marrow are less pronounced with  $\text{Y}^{90}$  than with  $\text{Au}^{198}$ , and regeneration occurs definitely faster with the former isotope.

There was found an unexplained increase in fat deposition in the marrow with  $\text{Y}^{90}$ . Although the toxicity of yttrium and the carrier probably does not play a significant role, it should be borne in mind.

In summary,  $\text{Y}^{90}$  offers certain practical and theoretical advantages when compared with  $\text{Au}^{198}$ .

One graph. GUENTHER A. DOEHNER, M.D.  
St. Vincent's Hospital, N.Y.

**Studies on an Iodinated Protein in the Serum of Subjects with Cancer of the Thyroid.** Jamshed R. Tata, J. E. Rall, and Rulon W. Rawson. *J. Clin. Endocrinol.* 16: 1554-1569, December 1956. (R. W. R., 444 E. 68th St., New York 21, N. Y.)

An iodinated substance (compound X), not present in normal subjects or those with non-malignant disease of the thyroid, has been found in the blood of about 60 per cent of patients with carcinoma of the thyroid. In this study the authors obtained compound X, labeled with  $\text{I}^{131}$ , from sera of 3 patients with thyroid cancer and investigated some of the properties of this substance, particularly its relationship to serum albumin.

Compound X appears to be homogeneous on ultracentrifugation and is the same from patient to patient. Its sedimentation constant is  $S_{20,W} = 4.2-4.3$ . Electrophoresis at pH 8.6 and 4.5 and most commonly used methods for protein fractionation did not distinguish compound X from iodinated serum albumin; however, experiments revealed that the compound is not protected from thermal precipitation by sodium caprylate, nor is it precipitated by rabbit anti-albumin anti-serum. When hydrolyzed by trypsin, compound X yields the iodinated amino-acid moniodotyrosine and another amino-acid that may be thyroxine.

One radioautogram; 2 graphs; 4 tables.

JAMES A. BURWELL, M.D.  
Pittsburgh, Penna.

**An Unusual Iodinated Protein of the Serum in Hashimoto's Thyroiditis.** Charles A. Owen, Jr., and William M. McConehey. *J. Clin. Endocrinol.* 16: 1570-1579, December 1956. (Mayo Clinic, Rochester, Minn.)

The serum of 38 female patients with Hashimoto's thyroiditis and 14 patients with acute diffuse (granulomatous) thyroiditis was analyzed for butanol-soluble organic  $\text{I}^{131}$  (thyroxine) and butanol-insoluble organic  $\text{I}^{131}$  (thyroglobulin) following administration of tracer

doses (68 to 500 microcuries) of the isotope. In most patients with Hashimoto's thyroiditis who had not progressed to the point of athyrosis, a significant amount of butanol-insoluble organic  $\text{I}^{131}$  was found, i.e., the thyroxine to thyroglobulin ratio was considerably less than 10:1. In addition a few patients had abnormally increased concentrations of thyroxine  $\text{I}^{131}$  or of some closely related compound. Significant amounts of thyroglobulin  $\text{I}^{131}$  appeared in the serum of only a few patients with acute diffuse thyroiditis.

Chromatographic studies of butanol extracts of trypsin-hydrolyzed thyroid glands from 8 patients with Hashimoto's thyroiditis and 1 patient with acute diffuse thyroiditis revealed a distribution of radioiodinated compounds comparable to that in normal thyroid glands.

Four tables.

JAMES A. BURWELL, M.D.  
Pittsburgh, Penna.

**Effect of Estrogen on Thyroidal and Renal Clearance of  $\text{I}^{131}$  in the Rat.** Joseph D. Feldman. *Am. J. Physiol.* 187: 369-372, November 1956. (Department of Pathology, University of Pittsburgh School of Medicine, Pittsburgh, Penna.)

An investigation initiated for study of the effect of estrogen on thyroidal clearance is reported. The administration of estrogen for three days to castrate and hypophysectomized rats was found to increase markedly the thyroidal clearance of  $\text{I}^{131}$ . When given for fifteen and thirty days, estrogen doubled thyroidal clearance in hypophysectomized rats but was without effect in castrate animals. Renal clearance was slightly decreased by the injection of estrogen.  $\text{I}^{131}$  space and serum  $\text{I}^{131}$  levels were not significantly influenced. These experiments indicate a direct action of estrogen on the thyroid.

Two tables.

**Renal Excretion of Radioiodide in the Dog.** Gerhard Giebisch, Martha B. MacLeod, and Frederic Kavalier. *Am. J. Physiol.* 187: 529-535, December 1956. (M. B. M., Department of Physiology, Cornell University Medical College, New York, N. Y.)

Radioiodide and creatinine clearances were measured simultaneously in dogs. Osmotic diuresis was induced by loading with mannitol, sodium salts of various anions such as chloride, bromide, iodide, nitrate and ferrocyanide, and by the administration of mercurial diuretics. Results of these experiments are compared with those obtained during water diuresis. No evidence for active tubular reabsorption of radioiodide could be observed. Renal tubular reabsorption of  $\text{I}^{131}$  was found to be chiefly determined by the degree of tubular water reabsorption and hence the transtubular diffusion gradient of radioiodide. Non-specific effects of other anions in the tubular urine may modify passive tubular reabsorption: anions less readily reabsorbed displace  $\text{I}^{131}$  from the urine and depress its renal clearance. Indirect evidence suggests that about 95 per cent of filtered radioiodide is reabsorbed at a tubular site proximal to that of final water reabsorption.

Three figures; 2 tables.

AUTHORS' ABSTRACT



## RADIATION EFFECTS

**Radiosensitivity of Bone.** S. di Rienzo. Fortschr. a. d. Geb. d. Röntgenstrahlen 85: 643-658, December 1956. (In German) (General Paz 151, Córdoba, Argentina)

The statement of Bergonie and Tribondeau that bone is highly radioresistant can now be accepted only in a limited sense. Bone is a complicated dynamic organ in which the osteoblasts, the osteoclasts, and the red marrow may be directly affected by radiation. The indirect effects, secondary to those on the blood vessels and the lymphatics, may be pronounced in adult bone. Intruterine bone is so sensitive that an embryo of three to five months will be grossly deformed by less than a 50 per cent skin-erythema dose. Toward puberty the diaphyses of long bone become more and more radioresistant, but the epiphyses maintain their sensitivity. In 1903, Perthes demonstrated that bone growth could be halted by x-rays, and in 1906, Forsterling showed that inhibition of growth by radiation was directly proportional to age. In the adult, the secondary vascular effects of radiation predominate. Spotty bone atrophy and irradiation necrosis of the femoral neck, of the mandible, and of the ribs are well known.

A series of cases illustrating the effects of radiation in reducing bone growth is recorded. Thus, a young girl showed reduction in the length of the lower ribs eight years after irradiation for hemangioma (dose unknown); in a boy of fourteen one shoulder was only about half normal size ten years after it had received 12,000 r for a reticulosarcoma; a hand given 3,000 r at the age of three was 25 per cent smaller, at the age of fifteen, than its mate. Of particular interest was a case in which the entire leg exhibited a decrease in size, though irradiation had been limited to a port over the knee.

An exception to the rule of growth inhibition by radiation was observed in a girl who at the age of seven received 2,400 r to the hand for a tumor of somewhat questionable type. Two years later, the circumference of the irradiated hand was definitely larger than that on the opposite side. A second case showing a departure from the usual pattern was that of an osteoma of the femur developing subsequent to radiation. Other factors were undoubtedly operative in this case.

A man of thirty received intensive irradiation of the forearm for a sarcoma. Subsequently painless pathologic fractures occurred through the bone, which exhibited spotty osteoporosis. A similar case is that of a male aged twenty-two, who, ten years prior to the study, had received irradiation for a giant hemangioma over the humerus. Spotty atrophy ensued, followed by pathologic fracture and, amazingly enough, by good healing.

Gross overdosage, particularly with gamma radiation, leads to a somewhat more immediate bone necrosis and the type of change quite aptly termed a radionecrosis. In the case of a carcinoma of the skin, treated with radium, necrosis developed in the frontal bone, with erosion into the frontal sinus. In this instance, high roentgen dosage, trauma, infection, and sulfanilamide all played a part. Another patient presented himself with sequestration of the entire mandible following a dose of 6,000 r for a carcinoma of the gum. The sequestrum was removed under light anesthesia with practically no bleeding. In the case of the mandible

it is important not to confuse radiation necrosis with osteomyelitis. The latter has a favorable prognosis and will respond to chemotherapy. Radiation necrosis requires surgery.

Thirty-four roentgenograms; 12 photographs.

WILLIAM F. WANGNER, M.D.  
Royal Oak, Mich.

**Effect of Radiotherapy on Bone-Marrow in Ankylosing Spondylitis.** J. W. Stewart and Stanley Dische. Lancet 2: 1063-1069, Nov. 24, 1956. (J. W. S., Bland-Sutton Institute of Pathology, Middlesex Hospital, London, England)

An investigation undertaken to determine the effects of deep x-ray therapy on the bone marrow of patients with ankylosing spondylitis is described. Observations were made on 54 patients attending the Meyerstein Institute of Radiotherapy (London, England). Of these, 46 were men. Twenty-nine had not been previously treated with irradiation; 25 received deep x-ray therapy in the past, some at other hospitals.

The results of bone-marrow examination in 28 of the untreated cases of ankylosing spondylitis are recorded. In 3 cases the peripheral blood showed mild hypochromic anemia, the blood counts of the remainder being within normal limits. The bone marrow was hypercellular in 39 per cent and of normal cellularity in the remainder. An increase in the number of lymphocytes and/or monocytes was found in 79 per cent. In only 1 case was there a plasmacytosis.

The effect of irradiation of bone marrow to a dose of 1,020-1,640 r is to cause aplasia, and this was observed in all the cases in which the marrow was examined from two days to six months after the end of treatment. Examination from fifteen months to fourteen years after irradiation revealed that regeneration is usually incomplete. Seven of 10 marrows so examined showed aplasia or hypoplasia.

Examination of bone marrow distant from the treatment areas during the six months following completion of radiotherapy disclosed only transient changes. These were hyperplasia of erythroid precursors and hypoplasia of cells of myeloid and lymphoid series. When examination was made more than six months after the end of treatment, the findings were similar to those in patients who had not been irradiated.

Twelve figures; 6 tables.

**Osteogenic Sarcoma of the Skull Following Irradiation.** E. M. Skolnik, E. J. Fornatto, and J. Heydemann. Ann. Otol., Rhin., & Laryng. 65: 915-936, December 1956. (University of Illinois College of Medicine, Chicago, Ill.)

The authors present 2 cases of osteogenic sarcoma of the skull following irradiation. The first patient had been treated for keloid formation in the post-auricular area, receiving a total of 6,050 r (in air) delivered over a period of fourteen months. The second patient had been given approximately 9,000 mg. hours of radium and radon treatment over a period of nine months, for retinoblastoma. Eight cases of osteogenic sarcoma of the skull bones in patients who had previously received radiation to the area of involvement are also reviewed.

An analysis of the 10 collected cases showed the average age to be twenty-seven years, with 8 of the 10

cases occurring between nine and thirty-four years. The authors state that their own cases support the contention of Cahan *et al.* (Cancer 1:3, 1948. Abst. in Radiology 52:619, 1949) that a minimum tissue dosage of 3,000 r is required for the development of osteogenic sarcoma, and the observations of Neuhauser *et al.* (Radiology 59:637, 1952) that only dosages in excess of 2,000 r will produce disturbances in bone irrespective of the age of the patient. The prolonged mode of irradiation and a latent interval of at least three years are considered by the authors as important factors in the development of osteogenic sarcomas of the skull following irradiation. They state that extensive and prolonged radiation therapy for benign conditions should be avoided, but this should not prevent the judicious use of radiation when indicated. It is of interest that in 7 of the 10 collected cases the original course of irradiation was given for benign conditions.

Six figures; 1 table.

JAMES E. BAUER, M.D.  
University of Missouri

**Post-Irradiation Fractures of the Neck of the Femur.** W. H. Stephenson and B. Cohen. J. Bone & Joint Surg. 38-B: 830-845, November 1956. (Postgraduate Medical School, London, England)

The authors report a series of 21 femoral neck fractures (in 17 patients) following pelvic irradiation. Approximately 200 such fractures have been recorded. Fourteen of the authors' patients were followed for at least three years after the diagnosis of fracture. There were 2 deaths and 1 case was followed for only eleven months. All of the patients had received deep x-ray therapy for uterine carcinoma, and in some of the patients, the external irradiation was supplemented by radium. In some cases x-ray therapy was administered by a six-field technic which included direct lateral fields, but in later cases the lateral fields were omitted. The skin dose was 3,000 r to each field in every instance. All of the fractures reported in the present series were of the subcapital type.

The incidence of post-irradiation fracture of the femoral neck is between 2 and 3 per cent in various series. As would be expected, the fractures occur almost exclusively in women, and the patients are usually in the sixth or seventh decade of life.

The usual presenting complaint is pain, which may be located in the hip, referred to the knee, or take the form of sciatica. Pain usually follows the irradiation by an interval of a few months to several years. When the fractures are bilateral, the symptoms and signs may arise concurrently or there may be an interval of months or years before the second hip attracts attention. Initial examination of the hip is negative; later there may be pain at extremes of movement; finally, a coxa vara deformity may become evident.

Radiographically there is first noted an irregular transverse line of increased density in the femoral neck, either subcapital or high transcervical. Small scattered circumscribed areas of increased radiolucence may also be seen before actual fracture of the bone. A line of separation first becomes apparent at the lateral margin of the femoral neck. When the fracture line is complete, it is not so clearly defined as in an ordinary fracture. There is usually coxa vara deformity but with little or no angulation of the head on the neck.

Methods of treatment are variable and in general are the same as for simple femoral neck fractures. Prognosis is favorable. In 12 of the authors' cases there was

complete and in 2 incomplete bony union. There were 2 cases of necrosis and collapse of the femoral head. One patient was treated with arthroplasty.

The authors believe that osteoporosis is the predominant feature preceding fracture. Histologic studies in 3 cases and evidence of healing in others indicate that avascularity is not the underlying cause of the fracture.

Two roentgenograms; 9 photomicrographs; 1 table.

BYRON G. BROGDON, M.D.  
Parks Air Force Base, Calif.

**The Effect of X Rays on the Ovaries in Childhood and Adolescence.** H. Schreiber and Z. Polishuk. Brit. J. Radiol. 29:687, December 1956. (H. S., X-ray Therapy Department of the Workers Sick Fund (Kupath Holim), Haifa, Israel)

Heavy irradiation of the female pelvic organs may or may not permanently damage ovarian tissue. The authors report the case of a 14-year-old-girl who received 5,600 r (in air) through wide anterior and posterior pelvic portals in thirty-eight days, for dysgerminoma. In spite of the treatment, ovarian function has apparently continued normal with no interruption of menses and with vaginal smears indicating normal follicular and luteal phases.

As a result of surveying the literature and from their own experience, the authors feel that younger patients are less likely to be permanently castrated by irradiation than are older ones. The difference in sensitivity is attributed to the fact that large mature follicles are more easily affected than the primary follicles.

DON E. MATTHIEN, M.D.  
Phoenix, Ariz.

**Radiological Hazards Due to Exposure to Low-Energy Radiation in Veterinarians. An Environmental Study.** A. Abrahams, S. J. Harris, I. Paul, and G. W. Paul. Arch. Indust. Health 14: 521-525, December 1956. (Division of Industrial Hygiene, New York State Department of Labor, New York, N. Y.)

For a survey of radiation hazards in veterinary practice, 60 establishments were selected at random in the New York Metropolitan area. Fifty of these currently used x-ray units. Fluoroscopy, which presents a greater hazard than radiography, was found to be employed more extensively. Measurements of the intensity of the radiation and estimates of the duration of exposure revealed potentially hazardous conditions in a considerable proportion of the establishments. Actual damage had been suffered by some veterinarians and is the subject of a separate report.

Lack of "safety consciousness" in choice and use of equipment and in neglect of protective measures adds to the hazard.

A number of factors necessary to adequate control, applying the cardinal radiation protection principles of time, distance, and shielding, are discussed. These measures can be effective only when intelligently applied by knowledgeable persons.

**Radiation Protection.** E. F. Gloyne and J. C. Rude. Texas J. Med. 52: 853-860, December 1956. (J. C. R., Brackenridge Hospital, Austin, Texas)

This paper is concerned with protection not against disaster radiation but against radiation as a result of either nuclear or extranuclear adjustments in a normal peacetime development. In dealing with radioisotopes

it points out that modern methods of treating water and waste water aid in the removal of many radioactive isotopes. So far, too, the use of radioisotopes is such that for the present the major radiation problems still center around radium and x-ray units. It is expected that the number of x-ray machines will nearly double between 1949 and 1964. In addition to their increasing use by hospitals and qualified radiologists, they are also owned and operated at the present time by 69 per cent of the chiropractors in the country, 74 per cent of the chiropodists, 54 per cent of the osteopaths, and 46 per cent of the veterinarians.

While original designs for installation of x-ray and radium units are usually adequate for shielding, defects in construction may appear in the door systems, the ceiling and wall corners (especially where heating and air conditioning ducts are a part of a false ceiling), and around light plugs and structural members. There may also be deficiencies on the overlap of lead block, or lead sheets. Design records are sometimes lost, low-power equipment gives way to higher-powered without reference to the original shielding specifications, and physicians and technicians frequently become careless in personal exposures or do not check radiation levels. Installations in use with questionable shielding facilities or where operational techniques might be improved should be checked by qualified engineers or physicists.

"In the truest sense of public health the solution to x-ray and radium protection is an aggressive educational program. This educational effort can best be supplemented by the use of only competent scientists, physicians, and engineers who have the required technical background."

#### EXPERIMENTAL STUDIES

**Relative Biological Efficiency of 1000-Kvp and 250-Kvp X-Rays. I. General Introduction. Determinations Based on the Dose-Survival Curves of *Saccharomyces cerevisiae*, Haploid and Diploid.** Henry I. Kohn and Shirley E. Gunter. *Radiation Res.* 5: 674-687, December 1956. (H. I. K., Radiological Laboratory, University of California School of Medicine, San Francisco 22, Calif.) **II. Supplemental Determinations Based on the Dose-Survival Curves of *Escherichia coli* and *Rhodospseudomonas spheroides*.** Henry I. Kohn and Shirley E. Gunter. *Ibid.* pp. 688-692. **III. Determinations Based on the LD<sub>50/28</sub> Dose and the Killing Time of the Mouse.** Henry I. Kohn and Robert F. Kallman. *Ibid.* pp. 693-699. **IV. Determinations Based on the Dose-Response Curves for Testicular Weight in the Mouse.** Henry I. Kohn and Robert F. Kallman. *Ibid.* pp. 700-709. **V. Determinations Based on the LD<sub>50</sub> of the 4-Day-Old Chick Embryo.** Henry I. Kohn and Robert F. Kallman. *Ibid.* pp. 710-714.

Kohn and his associates report a series of studies of the relative biological efficiency of 1,000-kvp as compared to 250-kv constant potential x-rays, based on varying test materials as indicated by the subtitles. The range was from 0.78 to 0.91.

**Modification of Early Radiation Death in Guinea Pigs.** H. L. Andrews and K. C. Brace. *Am. J. Physiol.* 187: 378-380, November 1956. (Radiation Branch, National Cancer Institute, Bethesda, Md.)

In an effort to gain further insight into "early" or "central nervous system" death in guinea-pigs following

irradiation, the authors attempted to modify the survival time with a variety of pharmacological agents. Pentobarbital given in anesthetic doses prior to irradiation dramatically altered the course of injury induced by whole-body doses of 6,000 r or more. Survival time was sharply increased, and all signs of convulsions and hyperexcitability were suppressed. Phenobarbital and paraldehyde showed similar actions, but the margin of safe dosage is smaller than with pentobarbital. The action of pentobarbital appears to be a true radiation protection. Other drugs, such as diphenyl hydantoinate, suppress convulsive activity and lengthen survival time slightly. This is probably due to a sparing action from the intense muscular activity associated with convulsions. None of the drugs tested produced any effect when given after irradiation.

#### Endogenous Histamine Excretion in the Rat as Influenced by X-Ray Irradiation and Compound 48/80.

James L. Leitch, Virginia G. Debley, and Thomas J. Haley. *Am. J. Physiol.* 187: 307-311, November 1956. (Division of Pharmacology & Toxicology, Atomic Energy Project, University of California School of Medicine, Los Angeles, Calif.)

Studies were made on a spasmogen from rat urine, which has been identified as histamine. It is shown that both acute whole-body x-irradiation and compound 48/80 (a histamine liberator) significantly increase the quantity of this endogenous urinary histamine. Endogenous histamine excretion in female rats is approximately nine to ten times greater than in male rats. Neither x-ray irradiation nor compound 48/80 elevate the amount of urinary histamine of the males to that of the female.

Histamine liberation is of little or no importance in so far as lethality from acute whole-body irradiation is concerned. The amount of histamine liberated by such irradiation is independent of radiation dosage within the range 600-1,200 r. After radiation injury, significant levels of urinary histamine were detected only during the first twenty-four hours.

Histamine depletion by chronic administration of compound 48/80 did not prevent further liberation of histamine by acute whole-body irradiation. Irradiated animals are much more susceptible to the toxic effects of compound 48/80 than normal animals.

Gonadectomy followed by  $\alpha$ -estradiol injection did not increase the output of urinary histamine in male rats. Similar treatment of female rats did not reduce their urinary histamine output, but a reduction was observed one hundred and forty days after surgery. Administration of cortisone acetate to male rats did not increase their excretion of endogenous histamine, nor did inactivation of diamine oxidase with aminoguanidine show any significant effect on urinary histamine output in males, though it caused a threefold increase in females. Further elevation in urinary histamine was produced by irradiation or compound 48/80.

Three figures; 3 tables.

AUTHORS' ABSTRACT

**Metabolism of Glucose and Fructose in Liver of the Rat Subjected to Whole-Body X-Irradiation.** R. Hill, J. Kiyasu, and I. L. Chaikoff. *Am. J. Physiol.* 187: 417-421, December 1956. (Department of Physiology, University of California School of Medicine, Berkeley, Calif.)

Metabolism of glucose and fructose in the liver of the

rat exposed to 1,000 r of whole-body x-irradiation was studied. Liver slices prepared from normal rats and from irradiated rats were incubated with  $C^{14}$ -glucose and  $C^{14}$ -fructose, and the conversion of the  $C^{14}$  to  $CO_2$ , glycogen, and fatty acids was measured. The recoveries of  $C^{14}$  in these products from the labeled glucose were greatly reduced in the experiments carried out twenty-four, forty-eight, and seventy-two hours after irradiation. The  $C^{14}$  recoveries in the corresponding experiments with  $C^{14}$ -fructose were in the normal range. A single intravenous injection of glucose on the third day after irradiation was followed by no increase in the liver glycogen. The same treatment with fructose doubled the glycogen content of the liver. The continuous intravenous administration of glucose, begun immediately after the irradiation and maintained for three days, resulted in liver glycogen values of 0.7-1.9 per cent. The same course of treatment with fructose resulted in glycogen values of 4.2-5.0 per cent. Fasting was ruled out as an explanation of the defective glucose utilization observed in the liver of the irradiated rat. Possible sites of action of ionizing radiations on the paths of hexose metabolism are discussed.

Two figures; 4 tables.

#### AUTHORS' ABSTRACT

**Effects of Total Body X-Irradiation and Plutonium Injection on the Cholinesterase of Erythrocytes and Brain.** Jean C. Sabine, with the technical assistance of Helen M. Miller and Dorothy J. Nickolai. *Am. J. Physiol.* 187: 275-279, November 1956. (University of California School of Medicine, San Francisco 22, Calif.)

The author found that both total-body x-irradiation (25-300 r) and plutonium injected intraperitoneally ( $0.63\mu c$   $Pu^{239}$ ) produce an increase in the cholinesterase activity of erythrocytes of mice on the fourth day. In mice given 300 r, high values were observed on the third to fifth days. Subsequently there was a sharp fall in this titer to values far below normal at the end of the first week. During the second week recovery began and was apparently complete by the end of the third week. The reticulocyte count was significantly depressed during the first week, and there was a small but significant reticulocytosis during the third. In the plutonium-injected mice, the same early peak was noted and the same fall to values well below normal. There was no recovery during sixty-three days of observation. Data are presented for the fourth day following doses of x-rays from 15 to 300 r. From 25 r upward there is a significant increase in the mean cholinesterase titer. There appears to be a close relationship between the proportion of high individual titers and the dose, and the highest individual values were observed at 300 r. Data are also presented on a large series of control mice, and these are shown to conform well to the normal distribution as evaluated by *k*-statistics.

Three figures.

**Inactivation of Cholinesterases by Gamma Radiation.** Jean C. Sabine, with the technical assistance of Dorothy J. Nickolai and Helen M. Miller. *Am. J. Physiol.* 187: 280-282, November 1956. (University of California School of Medicine, San Francisco 22, Calif.)

Sprague-Dawley rats and *in vitro* preparations of cholinesterase were exposed to massive doses of gamma radiation from a barium-lanthanum source and from two x-ray sources. The cholinesterase activity and the activity-pS kinetics of rat brain were unaffected by an *in vivo* dose of 60,000 r from the isotope source. The

animals were in violent convulsion and had severe diarrhea at the time they were killed, within thirty minutes of the termination of the exposure. The activity of the whole human plasma was unaffected by 100,000 r of 1,000-kvp x-rays. Dilute hemolysate of human blood in 0.1 per cent gelatin was inactivated 10 per cent by 150,000 r of 250-kvp x-rays. Purified cholinesterase in dilute sheep serum was inactivated at a rate of 15 per cent/100,000 r of 250-kvp x-rays. In M/15 phosphate buffer containing 0.1 per cent bacteriological gelatin inactivation was at a rate of 50 per cent/100,000 r from the isotope source and in buffer alone at a rate of 21 per cent/10,000 r.

The relationship between dose and effect appears to be linear, and this is attributed to the very low concentration of enzyme molecules which makes the probability of a second hit negligible. The gradation of protection is regarded as a non-specific effect, a function of the concentration of large molecules which compete for the ionization. The enzyme was not protected by a high concentration of its substrate. While the enzyme can be inactivated by gamma irradiation, the conditions required are so different from those found in the intact animal that the signs and symptoms resembling cholinergic manifestations observed with supralethal doses cannot be explained in terms of inactivation of cholinesterase by the radiation.

One table.

**Effects of Graded Doses of Whole-Body X-Irradiation on Mast Cells in the Rat Mesentery.** F. P. Conte, G. S. Melville, Jr., and A. C. Upton. *Am. J. Physiol.* 187: 160-162, October 1956. (Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

In recent years interest in the fate of mast cells in irradiated animals has arisen in connection with investigations of the hemorrhagic phase of the radiation syndrome. The authors observed the mast cells in rats exposed to graded lethal and sublethal doses of x-radiation and sought to correlate changes in the number of such cells with dose and time postirradiation. During the first twenty-four hours after 75 r whole-body irradiation, a transient increase in the number of mast cells was observed; this was followed by a slight decrease. After larger doses of irradiation (150-600 r), the mast cells were not seen to increase, but decreased in number during the first two weeks after exposure.

One chart; 1 table.

**Effect of Localized Brain Stem Lesions and Supradiaphragmatic Vagotomy on X-Irradiation Emesis in the Monkey.** Kenneth R. Brizze. *Am. J. Physiol.* 187: 567-570, December 1956. (Department of Anatomy, University of Utah College of Medicine, Salt Lake City, Utah)

This report presents further information on the effects of specific lesions in nuclei in the general region of the emetic trigger zone as well as of supradiaphragmatic vagotomy, on the early vomiting response to 1,200 r total-body x-irradiation.

Bilateral ablation of *area postrema* by thermal coagulation was found to result in loss of the normal early emetic response to total-body x-irradiation in 3 monkeys (*Macaca irus*). Similar lesions in the lower descending vestibular nucleus, with some damage to *area postrema*, eliminated the vomiting reaction in 1 animal, but failed to do so in 2 others. Bilateral lesions in the dorsal sensory vagal nucleus without involvement of *area*



*postrema* or other structures failed to inhibit the vomiting response to the standard dose of irradiation. In 2 other animals with similar lesions, but with extensive damage to *area postrema* or the nucleus of the *tractus solitarius* on one side, no vomiting occurred. Two animals with bilateral lesions in the superficial (ventricular) portion of the hypoglossal nuclei vomited during irradiation or in the usual interval following radiation. Supradiaphragmatic vagotomy produced complete inhibition of vomiting in 5 animals.

Five photomicrographs.

**Effects of Low-Level X-Irradiation on Oxygen Consumption of Bullfrog Erythrocytes.** W. S. Martin, R. C. Grubbs, and M. A. Lessler. *Am. J. Physiol.* 187: 505-508, December 1956. (Department of Physiology, Ohio State University College of Medicine, Columbus 10, Ohio)

The respiration of nucleated erythrocytes from the bullfrog (*Rana catesbeiana*) was determined following exposure to either 25 r or 60 r x-irradiation. Using the Warburg technic, the rate of oxygen consumption of 50 per cent cell suspensions was studied at either 25° C. or 30° C. A decrease of 5° C. in the incubation temperature produced a marked decrease (approximately 20 per cent) in oxygen consumption of both non-irradiated and irradiated erythrocytes. There was a 10 to 15 per cent inhibition in oxygen consumption at an incubation temperature of 30° C. following both 25 r and 60 r. At 25° there was a 14 per cent depression following 60 r, but no significant change after 25 r. The radiation effect was modified by both time and temperature factors, indicating that these are related to the expression, rather than to the extent, of radiation injury. Consistent correlations between dose and radiation effect have been established.

One figure; 1 table.

#### AUTHORS' ABSTRACT

**Radiation-Induced Delay of Pupation in *Drosophila*.** Rose C. Bourgin, Rolfs Krumins, and Henry Quastler. *Radiation Res.* 5: 657-673, December 1956. (Department of Physics, University of Illinois, Urbana, Ill.)

X-irradiation induces delay of pupation in *Drosophila melanogaster*. The target zone for this effect is in the anterior third of the larva, probably the ring gland.

The authors' studies seem to indicate that the transition from larval to pupal stage depends on two systemic (probably hormonal) control mechanisms; one causes the termination of the larval stage, the other initiates the prepupal stage. Irradiation causes a dissociation of these two mechanisms; the termination of the larval stage occurs at the normal time, but the initiation of the prepupal stage is delayed. As a result there occurs an abnormal phase which is neither larval nor prepupal.

Histologic studies show two groups of changes: the direct effects, which become apparent within twelve hours of irradiation, and the probably indirect effects, which remain latent until the time when the prepupal stage normally begins. The delay of pupation is presumably due to a blocking of the production or the secretion of ring gland hormone, or possibly a brain hormone. It is interesting to speculate about the mechanism which finally does induce the prepupal stage. All that can be said at this time is that the recovery process, whatever its nature, must be one which is not affected by irradiation—otherwise the delay would not reach a constant value which is invariant with dose.

Eight figures.

**Experimental Treatment of Poisoning from Fission Products. Ability of Chemical Agents to Alter the Uptake and Retention of Fission Products in Animals Exposed to Radiactive Fall-out.** S. H. Cohn, J. K. Gong, and W. L. Milne. *Arch. Indust. Health* 14: 533-538, December 1956. (U. S. Naval Radiological Defense Laboratory, San Francisco, Calif.)

The ability of zirconium citrate and edathamil (EDTA) to alter the distribution and retention of both an injected mixture of long-lived fission products and an inhaled mixture of short-lived fission products was determined in mice and rats. The mixture of long-lived fission products contained those isotopes which present the most serious health hazard from the point of view of chronic internal irradiation. The whole spectrum of fission products used in the inhalation experiment reproduced an acute exposure to fall-out following nuclear detonation.

The more effective chemical agent for the prevention of skeletal deposition of both short- and long-lived fission products was found to be the zirconium citrate, preferably administered shortly before injection or exposure to mixed fission products (MFP). Post-treatment was also useful, within limits. Treatment following MFP exposure must be made within an hour for maximum effectiveness; after this time only slight changes in MFP retention are noted. Treatment which reduces the skeletal deposition effectively increases the deposition in the soft tissues other than the liver; this effect was observed with the zirconium citrate.

The most effective means of reducing the MFP content in the liver was pretreatment with edathamil and post-treatment with zirconium citrate. Excretion of MFP is also increased by this procedure. While the skeletal deposition is reduced, however, it is not altered as much as by pre-treatment with zirconium citrate alone.

Two figures.





